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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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BRIEFLY TOLD.

THE MINNEAPOLIS GAS RATE SEEMS TO BE SETTLED.—Remembering the many twists and turns which have occurred in the undeniably long drawn out attempts of the authorities and the Minneapolis Gas Company to agree upon a gas rate, it may seem more or less hazardous to write it down that a definite result has been reached and that the controversy is at end. However, that seems to be the case at this time of writing, the Company having, through President Brown, informed the City Council that it was willing to supply gas at $1.30 per 1,000 cubic feet, provided a reasonable time would be vouchsafed it to put itself in position to prepare for doing business at that figure. The Company believes that the period between the present time and the 1st of March, 1895, would constitute such "reasonable time," the gas rate to remain as at present in the interim. From our best advices, which are up to the 22d inst., the belief is that the authorities will accept the proposition—in fact, there is no reason to doubt that they are satisfied, since they have virtually gained all that their own arbitrators declared was sufficient. President Brown's sudden change of base is only explainable on the ground that his associates must have differed with him with a force sufficient to overrule his views, for be it known that he prides himself on his resoluteness of belief, although other people have held sometimes that obstinacy would be nearer the mark in defining the gentleman's policy on occasions when he failed to agree with others. Personally, no more genial or whole-souled man lives than H. W. Brown, and it is no task to be friendly with him, but the clearing away of the smoke resulting from the contest at Minneapolis rather seems to reveal him in a somewhat battered condition as a successful tactician. From the start of this agitation at Minneapolis, which is now an old story, an impartial observer could hardly fail to form the verdict that the Company rode too high a horse, and preferred to trust to whip and spur rather than to softer methods to get safely by the winning post. Another unfortunate outcome of the affair for the Company is the action of the authorities in doubling its assessment for purposes of taxation, which will increase its expense account on this score in the sum of $5,000. There was nothing else, however, for the assessor to do, since the Company's own experts testified that the plant and property were worth so much. The propositions submitted by President Brown will be found in our item columns. Now that the rate is virtually settled, we imagine that the people interested in the gas interests of the adjoining city of St. Paul are on the anxious seat; for despite the action of the St. Paul Gas Company in voluntarily making a $1.50 rate, it may be taken for granted that the goose in St. Paul will not cease squawking until that which the gander in Minneapolis has secured will come to pass.

THE GAS WAR IN MONTREAL.—The gas war between the old Montreal Company and the Consumers concern is at the noisy point, the proprietors of the former having announced a cut in rates to 95 cents net per 1,000 cubic feet for lighting and heating purposes. The rates from which the cut is made were: For lighting use, $1.30 per 1,000; for cooking, heating and power purposes, $1 per 1,000. In further mention of Montreal gas matters we might say that Judge De Lorimier has issued an injunction ordering the Consumers Company to cease supplying gas until May 1st, 1895, in accordance with his interpretation of the 6th clause of the contract existing between the city of Montreal and the Montreal Gas Company, which is as follows: "And the said city of Montreal aforesaid, during the said 10 years, that is to say, from May 1, 1885, to May 1, 1895, shall not grant to any other Company or party leave to open the streets or roadways, or to lay gas pipes in the streets except during the last two years of the contract, when the said city of Montreal shall have the right to authorize any other person or company that may be formed or then existing to lay pipes so as to be ready to

commence supplying gas on May 1st, 1895." The decision is rightly based on the literal interpretation of this contract, which specifies neither more nor less than that the Montreal Company was to be in exclusive possession of the gas supply of the city until May 1, 1895. After that time the field was open. The Consumers Company appealed, having given a bond.

NOTES.—A mortgage issue of $150,000 on the plant of the Lockport (N.Y.) Gas and Electric Light Company has been arranged for. The sum of $135,000 will be issued at once, and the balance will be emitted on February 1st, 1895. The International Trust Company, of this city, is the Trustee.——The concern which has taken over the Mount Holly (N. J.) works does not propose to confine itself to that venture, but will operate lighting plants wherever such operation seems to promise a profit. It is to be known as the New Jersey Gas Improvement Company, with a capital of $100,000. The incorporators are Messrs. G. W. Wright, G. W. Schriner, F. C. Viney and S. R. Gaskill.——The Port Jervis (N. Y.) gas works have been sold to parties resident in Portland, Me. Mr. G. F Duncan, of that city, is said to be the controlling factor in the new ownership.

[Prepared for the JOURNAL.]

Pressure of Gas at Different Elevations.

By MR. J. P. GILL.

As a supplement to the article in the JOURNAL of August 13th on this subject, it may be well to add the following. That article refers only to temperatures above 32° F. If the temperature should be below that number of degrees, the formula for finding the specific gravity at 32° will be $\left(1-\frac{32^\circ - T'}{490}\right)$ × by the specific gravity at $T' = S$; T' being the degree at which the specific gravity is taken.

In illustration, let the specific gravity be taken at 4° F., and let it be found to be .3588; then, $\left(1-\frac{32^\circ - 4^\circ}{490}\right) \times .3588 = .3383 = S$, the specific gravity at 32°. It will be perceived that the gas in this instance is identical with that in the preceding paper, having a specific gravity of .32 at 60° F. If the declivity be 100 feet, R will be the same as before, 1.55234, and so will also $R-(R \times S)$, viz.: 1.02718, the same difference in pressure.

If the gas descends instead of rises—*i. e.*, if there be a declivity instead of an elevation—the formula $R-(R \times S)$ = Difference in pressure continues unaltered; but of course the difference must be deducted from the pressure at the level at the top of the declivity to find the pressure at the bottom.

The equation $R-(R \times S)$ = Difference in pressure may be further generalized. Let Dh be the difference in height, and Dp'' the difference in pressure; then $(.0155234 \times Dh) - (.0155234 \times Dh \times S) = Dp''$, or $.0155234 \times Dh\,(1-S) = Dp''$, S being the specific gravity at 32°. Dh may be called H for the height of the elevation.

It would also be well to have in mind, in further illustration of the principles involved, the following ratios, P and S being the pressure and specific gravity of the gas at 32° F., p and s those at any degree, T above 32°, p' and s' those at any degree, T' below 32°, and v the volume at 32°, V that *above* 32°, and V' that *below* 32°. By the different volumes, in any one of the following equations, is meant the same weight or quantity, or, more strictly speaking, the same *mass* of the gas in different states of expansion or contraction, arising from difference of height and temperature.

As previously shown, $P + Dp'' = p$, and p (at T) : P (at 32°) :: s (at T) : S (at 32°) :: v (at 32°) : V (at T), and $v : V :: 1 : 1 + \frac{T - 32^\circ}{490}$.

If the temperature be less than 32°, $P - Dp'' = p'$, and p' (at T') : P (at 32°) :: s' (at T') : S (at 32°) :: v (at 32°) : V' (at T'), and $v : V' :: 1 : 1 - \frac{32^\circ - T'}{490}$.

These equations are for differences of temperatures; for differences of height, other equations are required, as follows:

Let Pb and Sb be the pressure and specific gravity at the bottom of an elevation, and Pt, St those at the top, and Vb, Vt the volumes at the bottom and top. Then $Pb + Dp'' = Pt$, and $Pb : Pt :: Sb : St :: Vt : Vb$.

For a depression or descent, let Pt' and St' be the pressure and specific gravity at the top of the descent, Pb' and Sb' those at the bottom, Vt', Vb' the volumes at the top and bottom. Then $Pt' - Dp'' = Pb'$, and $Pt' : Pb' :: St' : Sb' :: Vb' : Vt'$.

[Prepared for the JOURNAL.]

Electric Lighting versus Gas.

By MR. EDWARD M. HARRIS.

There can be no doubt that a strong feeling of dissatisfaction with, and want of confidence in and concerning the electric light exists in Great Britain, not only among its consumers in the chief cities and towns, but throughout the entire country, whether receiving their current from electric lighting companies or from corporation installations paid for by funds taken from the poor old money chest of the public; in which latter case the taxpayers, particularly those who are not consumers, are creating a lively agitation against electricity, and in favor of returning to the old method of lighting the streets and public buildings with gas.

That this widespread and still extending excitement and opposition exist does not surprise serious thinkers and careful observers, because they realize that communities and individuals have a penchant for everything wonderful and novel, particularly when seduced to believe such novelties will enhance their comfort, convenience and pecuniary advantage.

Until electric lighting was introduced into England, the people generally knew but little indeed concerning electricity, nor did they manifest any interest in the science; but the novel light was so adroitly heralded before the British public, by the interested promoters of electricity, that a craze for its adoption was created. Thousands of individuals, shopkeepers and others, hastily, to their after regret, discontinued using gas and had the electric light installed; and some communities and municipal bodies, without giving the matter too much consideration, recklessly expended large sums of money and incurred great liabilities by erecting and maintaining complete electric lighting plants, which, in most cases, proved a continuous cost, heavy loss, and an onerous burden to taxpayers. The popularity of electric lighting proved in hundreds of cases very ephemeral, and after a butterfly existence gas was restored to popular favor.

During the last lustrum of years, especially within the last two of that period, the people generally have become more enlightened on the subject of both electricity and gas as illuminants; the individual consumers of electric lighting have gained the best of wisdom—the fruit of experience. The honest and independent newspaper press has also proved a very valuable instructor, while, at the same time, the journals devoted to gas interests, upheld with admirable courage, zeal and perseverance the system of gas lighting, and with great ability successfully combatted and demolished the shallow, sophistic and specious assertions and arguments of their arrogant opponents, the electricians.

The publication of recent happenings in Great Britain, of others elsewhere, the literal circulation of items of interest concerning electricity and electric lighting, as to its cost, inconstancy, quality and power, its detriment to the vision, its imperfections for display and its dangers to property and life, all proved very effective in creating feelings of general surprise, and in some localities even of consternation and dismay.

Many of the principal shopkeepers in the town of Hastings have been loud in their complaints of the uncertainty of the electric lights, and several, for that reason, have discontinued their use and returned to gas. On Bank Holiday the electric lights at the baths went out, causing some fright and much confusion. At the same time the arc lamps on the pier and along the sea front also failed, and the gas lamps had to be lighted.

In Paris, very recently, the arc lamps lighting the Boulevard de la Madeleine and the Place de l'Opera went out very suddenly owing to some trouble with the machinery.

A ludicrous incident occurred at the town of Redfern, Australia, on the evening of the installation of the electric light in the principal business establishment there, a large number of invited guests being present at the time. The Mayor, while expatiating on the beauty and many advantages of electric light, as compared with gas, was interrupted by the sudden going out of all the lights, which caused laughter and ridicule. His Honor, the Mayor, was, however, equal to the occasion; he cordially invited all present to accompany him to the Town Hall, which was illumined by the electric light; they did so, but, by a strange fatality, in the very midst of the proceedings, the assemblage, and without a moment's warning, were again left in darkness. Every electric light went out.

These occurrences proved disastrous to the promoters of electric lighting, as very many of the shopkeepers and others, who were favorably inclined towards the method, determined to "let well enough alone," and continue using gas.

The same wise decision has been arrived at by the Court of Common

Council of the city of London. The committee they appointed to take charge of the experiments of lighting the Mansion House by the electric lights, with instructions to make an official statement as to its advantages or otherwise as an illuminant over gas, after lengthy and crucial tests, reported unfavorably of electricity for purposes of illumination, especially regarding its inability to satisfactorily display the magnificent and beautiful painted windows. The Court of Common Council, after discussion, recommended reverting to the old system of lighting with gas, which, besides being reliable, effective, and meeting all necessary requirements, would only entail a cost of less than one-half that of electricity to the corporation.

The illuminating power of the electric light has been very grossly exaggerated, and the credulity of the general public imposed upon, they not being aware, until recently, of the quadruple system of measuring that light—the technical or trade terms, 200-candle power, 2,000-candle power, and so forth, were misunderstood. For their enlightenment on the subject, they are largely indebted to a distinguished citizen of the United States, General A. Hickenlooper, President of the Cincinnati Gas Light and Coke Company, a Company possessing facilities for also furnishing electric lighting. This eminent authority on the subject of both systems of lighting issued a circular a few months ago to the citizens of Cincinnati, copies of which reprinted *in extenso* have been liberally distributed in England, and much dissatisfaction is expressed concerning the value and power of the light, which but rarely maintains an equality of power for a few consecutive hours, but, on the contrary, steadily diminishes during long periods.

With reference to the electric light, the circular issued by General Hickenlooper says: "Its photometrical power has been greatly exaggerated in the minds of the public, through the use of the mere trade term 'two thousand candle power,' which is based upon what is known to science as the 'French' or four-way method of measurement. Thus, as compared with the usual photometrical system of measuring gas, such lamps should be rated and called 'five hundred candle power,' while, as a matter of fact, they seldom attain even this candle power at the point of ignition; and bearing in mind that light is dissipated inversely as the square of the distance, it must be evident that the commercial or practical value of this system cannot be favorably compared with an evenly distributed light, carried nearer the points of utilization. * * * * The illuminating power of gas, unlike the electric lamp, is constant and unchangeable."

The circular from which the above is simply a short extract, gives much valuable information concerning both the electric and gas systems of lighting, and has been much commented upon by the British public and the defenders of each method. Those interested in the system of lighting by gas are particularly well pleased.

Another cause of much complaint and discontent is the fact that no absolutely certain and satisfactory mode of ascertaining by measurement the exact amount of electric current supplied is in use; but the fact is, so far, no fairly even method of doing so has been discovered. Of all the electric meters submitted to the Board of Trade for their adoption, not one has met their approval, and at the present time there are no authorized means of determining either the quantity of current consumed or the value and power of its illumination.

Great surprise is manifested at this apparent lack of inventive genius among electricians in this particular direction. A perfectly reliable meter must surely be considered an instrument absolutely necessary and of paramount importance to both the suppliers and consumers of electricity.

[Concluded from page 259.]

The Gas Industry in the United States of North America.

[A lecture delivered at the meeting of the "Deutscher Verein von Gas und Wasserfachmannern," at Karlsruhe, June 18, 1894, by Herr von Oechelhauser, for a copy of which we are indebted to the courtesy of the lecturer.]

American Gas Works as Central Stations for the Supply of Light.—In passing from central gas works for the supply of heating to those for the supply of lighting gas, the European observer necessarily notices water gas first of all, this being the subject in which he is, as a matter of course, most interested. As was to be expected, the production of carbureted water gas may by this time be regarded as a fully solved problem, both technically and, as far as America is concerned, economically also. All I have to add to what Professor Bunte has already said on this subject is that personally I have the greatest confidence in that system devised by Mr. Alex. C. Humphreys, the former Managing Director of the United Gas Improvement Company, of Philadelphia, in co-operation with Mr. G. A. Glasgow, and largely represented by numerous plants scattered over North America. This system, as well as that of Professor Wilkinson (for light carbureting oils only), appeared to me to be particularly reliable and workable, quite apart from the good results it is certainly possible to obtain also by other arrangements. It would, however, be a mistake to suppose (and Professor Bunte did not fail to refute the notion) that the reason why water gas has become so rapidly and so widely popular within the last few years in America is to be found in any appreciable reduction in the cost of manufacture of the water gas, as used for lighting. The fact is I have found that in most of the establishments manufacturing water gas and coal gas, the average cost of both, taking it all the year round, whilst varying according to the price of the coal and oil, was upon the whole practically the same. To add but one striking example, which illustrates the fact that even in America the choice between water gas and coal gas is entirely dependent on local conditions, I may mention that in Cleveland, Ohio, on Lake Erie, where one of the headquarters of the large petroleum corporation, known as the Standard Oil Company, is situated, and where, therefore, carbureting agents are not wanting and may be procured at a minimum cost for transport, not one cubic meter of water gas, but solely coal gas, is produced, the reason being that the bye-products obtained in the manufacture of coal gas, viz., coke, tar and ammonia, command good prices in that locality. The sale price of lighting gas,[1] on the East side of the Rocky Mountains, generally varies between 14 and 24 pfennigs per cubic meter, being, therefore, very much the same as the price at which gas is supplied in this country; but only a few years ago these prices were considerably higher.

It was, however, extremely pleasant to notice how well the joint production of coal gas and water gas in the same works, and their simultaneous conveyance through the same network of pipes, was managed; also, how readily the two kinds of gas would mix in any desired proportions; and, lastly, how favorably this facility of mixing affects not only the manufacture but also the sale of the gas. The fact is that water gas, if burned alone, only gives a short, pointed and intensely hot flame, such as is least suited for heating cooking utensils, whereas the mixture of coal gas and water gas usually supplied by most establishments produces a longer flame, the temperature of which is not quite so high. Similarly, for use in gas engines, this mixture, which is known as "commercial gas," is far preferable to pure water gas, which burns away too rapidly in the engine and is too liable to self-ignition.[2] Besides, by mixing coal gas with water gas, the danger arising from the inodorousness of the water gas is averted in the simplest possible manner.

Thus you will see, gentlemen, that we have no reason whatever to be afraid of water gas, or to abuse it, and this affords me an opportunity of referring to a remark of Dr. H. Strache, of Vienna, who, in a recent issue of the *Journal fuer Gasbeleuchtung*, commented on my Berlin lecture. While Dr. Strache made a number of valuable observations in reference to my lecture, I must say that I think him to be mistaken when he upbraids me for what he calls my "too stringent criticism on water gas." I therefore take the liberty of correcting the few slight errors which he has made in this connection, in a short note appearing in the supplement to this paper, lest I should be accused of inconsistency by those who peruse my present remarks on water gas. Indeed, it was at that time my duty to state that "Auer's incandescent bodies or mantles were unsuited for water gas, their power of emitting light being very quickly impaired by chemical combinations." Well, that was saying no more than what Dr. Strache himself, in his lecture at Vienna, delivered six months later, expressed in these words: "But that method of illumination" (meaning incandescent burners fed with non-luminous water gas) "is attended with this characteristic inconvenience, that the burners in a very short time lose their illuminating power and have to be renewed, hence the invariable defective nature of the light as supplied hitherto by water gas." This, then, according to Dr. Strache, was the correct view to take, as recently as in May last year. However, I certainly did not say "that water gas would never become fit for use for incandescent gas lighting purposes," as Dr. Strache, in his last essay, alleges that I did. Dr. Strache, continuing, makes the very satisfactory statement that the assertion of mine regarding the unfitness of Auer's light for use in connection with water gas, "may at present be applied with justice only to the unpurified ferriferous gas; but that even this gas, on being applied to Auer's incandescent bodies or mantles, may be said to have given results which, upon the whole, were not altogether unfavorable; in fact, in many places it is actually being so used at the

1. A remarkable fact is that at the time I am speaking of, Cleveland, where no water gas is produced, was the very place of all which I visited where gas was cheapest.

2. I may here mention, by the way, that even in gas engines operated by natural gas the igniting flame has to be fed with coal gas, owing to the fact that natural gas is too readily extinguishable, while it can only be ignited with comparative difficulty.

present time. Water gas, which is free from iron, now produces light of such intensity as to exceed by two or three times the light given by Auer's lamp with coal gas, while the intensity of this light decreases in a far less proportion compared with that of the coal gas light."

If this invention of Dr. Strache's should prove a success, and if the statements which Herr H. Dicke made at the last annual meeting, with reference to the improvements made in Fahnehjelm's magnesia combs, etc., be verified upon being tested on a somewhat large scale in actual practice, this will simply amount to the practical realization of one of those contingencies which I had in view when I said, "That as soon as these economical conditions are fulfilled, and certain other requirements in connection with the method of production, etc., are met, in a way favorable to the adoption of water gas, the coal gas industry will turn its attention to it." This would, indeed, bring the cheaper non-luminous water gas more within our reach; whereas, hitherto, nearly all the financial difficulties which had to be overcome in Germany, and the many inventions which were made, had for their primary object the question of imparting lighting power or carbureting the water gas. Moreover, in addition to the removal of the iron from the water gas, and in the hope that the purified water gas will not become ironed again by mains which have no good asphalt coat inside, another far more difficult problem would, of course, remain to be solved, namely, the attainment of such a degree of perfection in the construction of the incandescent gas burners that all flat and Argand burners, wherever employed, may be replaced by them. But until this further progress is made, the present methods of supplying illuminating gas through flat and Argand burners cannot be discarded. At the same time, the outlook being what it is, the question regarding the advisability or otherwise of mixing together lighting gas and water gas, as is done in America, may not inappropriately be discussed now in Germany, since it appears, or it is to be hoped, that water gas no longer interferes with the practical performance of Auer's method of lighting, so that it may with all the more reason be taken for granted that no such interference need be apprehended where coal gas and water gas are mixed. Besides, an additional criterion which may serve as a guide in forming our conclusions, is furnished by the recent fact that benzol, which is now obtainable by a new method in abundant quantities, as a bye-product in the manufacture of coke, and which Professor Bunte has repeatedly recommended for this purpose, is now a readily available carbureting medium for Germany, which may render good service, if non-illuminating heating gas were to be diluted with water gas, making up for the deficient intensity of the light, at least so long as this be necessitated by the employment of Argand, regenerative and other similar burners, instead of using in future only incandescent lights fed with non-illuminating heating gas.[1]

The recent improvement to which I have referred as having been realized in the purification of water gas, with a view to its employment in incandescent burners (supposing that it is found to be practicable both from the technical and economical points of view), in my opinion seems to indicate, however, that we should probably be mistaken in copying the Americans by manufacturing lighting gas from 18 to 28-candle power, instead of gas averaging 15 or 16-candle power (such as ours), *i. e.*, increasing the illuminating power of the gas, on the average, about 1½ times. On the contrary, we hope to diminish our illuminating power the more and more, *i. e.*, with the further perfection of incandescent burners.

The reasons why the lighting power of gas has had to be increased in America, within the last few years, have been stated at considerable length by Professor Bunte. A circumstance which may have something to do with it, too, is that all incandescent burners, including the older burners of both Fahnehjelm and Auer, proved failures in America.

Indeed, this latter point is of such paramount interest that I may, perhaps, be permitted to dwell upon it a little longer. The two above mentioned older types of incandescent burners, as soon as they made their appearance in America, were so eagerly welcomed that when, subsequently, they proved defective in practice, the resulting reaction was proportionately severe; so much so that, in the course of my last year's American tour, I did not come across a single place, even including such centers of culture as New York and Boston, where Auer's new burners are in use to anything like an appreciable extent; while in Chicago, as I have before mentioned, the last extensive trial which has been made with Fahnehjelm's magnesia combs, had just been given up. The more eminent specialists in the gas industry with whom I was enabled to become acquainted—Mr. Eugene Vanderpool, of Newark, N. J., and some others—were the only persons who actually kept a few of the new incandescent bodies or mantles on Auer's system in use, by way of trial.

Germany may, therefore, be congratulated upon the fact that here the gas managers protected the consumers from too rash an introduction of any of the older forms of incandescent burners above alluded to, thereby more effectually insuring the quick adoption of the improved incandescent bodies or mantles. This, too, is one more proof in confirmation of the well-known rule that nothing can more seriously injure an invention than its premature introduction into general use, when either the invention itself is not yet "finished," or where, economically speaking, the market is still unprepared to receive it. And yet it seems pretty certain that in America, as well as elsewhere, incandescent burners will be the burners of the future, and that there are no difficulties peculiar to American life that are likely to impede their introduction. I found evidence bearing out this view when visiting the city of Montreal, Canada, where an intelligent and pushing Company (the Incandescent Gas Light Company, managed by Mr. Granger and Professor Bell), started for the purpose of working Auer's burners, had succeeded in the brief space of 3½ months in disposing of about 12,000 incandescent lamps. There seems, consequently, to be little doubt that the incandescent gas light will have another chance of gaining access to America, and it will conclusively show by-and-by the uselessness of such great intensities of light as flat and Argand burners still demand.

To convey an idea of the remarkable degree to which the illuminating power and durability of the Auer burners have already been recognized with us in Germany (they having, indeed, far exceeded our original expectations), I have extracted some statistical data on the subject from the returns of the "Deutsche Continental Gas Gesellschaft," and have inserted them in the Supplement.

It is, however, to be earnestly hoped that in this inventive age the bold anticipations cherished in regard to the further improvement of the incandescent bodies or mantles may be verified at no very distant period, so that we may soon be in a position to produce a bright light wherever it may be required, by means of an economical gas, not luminous in itself, and perhaps at some future time to exchange the unreliable, subjective photometer, operated by gas burners constructed on the old system, for the sure, objective calorimeter.[1]

3. ***American Gas Works as Central Stations for the Supply of Motive Power.***—Having examined the conditions of American gas works as central stations for light and heat, we may now pass on to the consideration of those works as central sources of power. In this respect we were quite as much disappointed in America as we had been in regard to the Auer burners; nay, whereas we are only about two years ahead of the Americans as regards these burners, America may be said to be nearly a decade behind us in respect of the development, profitable working, and general utilization of gas engines.

In a paper on "Gas Engines in the United States," read by Mr. F.H. Shelton, of the engineering staff of the United Gas Improvement Company, of Philadelphia, before the last meeting of the American Gas Light Association, at Chicago,[2] the reasons which account for this anomaly are clearly set forth, so that I need only add a very few words on this topic. He first proves, by statistical data collected by direct inquiry, that one gas engine is used on an average for every 7,500 persons,[3] while in Germany, from the very careful investigation made by Mr. Schaefer,[4] it appears that one gas engine existed in 1892 for every 940, or (taking it in round figures) every 900 inhabitants. Thus it will

1. The experiments made in Dessau, in the months of December, 1893, and January, 1894, in which benzol was used for carbureting and a repetition of which in a new apparatus (which has in the meantime been constructed) shall soon take place, have given very favorable results as regards the cost, yet the exact extent to which benzol condenses in the pipes is still an open question. However, from the interesting report of Dr. E. Schilling, read at the same meeting at Karlsruhe, it would appear that those practical experiments made in Munich have also shown favorable results with regard to condensation.

1. Professor Dr. A. Slaby, in a most valuable essay entitled "Calorimetrical Investigations into the Nature of the Cycle Process in Gas Engines," published in the Transactions of the "Verein zur Beforderung Gewerbfleisses in Preussen," for 1894, p. 175, makes the following remark:

"The somewhat complicated method, described in Chapter I., of ascertaining the value of lighting gas as a heating medium, by analysis, need not have been used for the purposes of the present work, inasmuch as industry, ever since 1892, has been in possession of an apparatus—viz., the calorimeter of H. Junkers—which enables the heating power to be ascertained in an extremely simple and reliable manner."

This expression of opinion is all the more remarkable as Slaby's investigations have been conducted and controlled with a high degree of scientific accuracy and precision, so that it may be taken for granted that the calorimeter named is sufficiently precise even for scientific experiments, to say nothing of the ordinary requirements of practice.

2. See the AMERICAN GAS LIGHT JOURNAL, Vol. LIX., p. 686, *et seq.*

3. Sixty towns, varying in their population between 8,000 and 555,000, and representing altogether a population of 4,000,000 inhabitants, were using 540 gas engines in all.

4. See *Journal fur Gasbeleuchtung und Wasserversorgung* for 1894, No. 16: "The Power Supply in German Cities by Lighting Gas," by Franz Schaefer, published by R. Oldenbourg.

be seen that the employment of gas engines with us is, comparatively speaking, 8 times greater than in America.

The number of gas engine builders is set down by Mr. Shelton as "20 at least," while in Germany, which is so much smaller than the American Union, the number of gas engine manufacturers is about 60 to 70, or over 3 times greater, even Mr. Krupp having recently become one of them. The "Otto" gas engine, as constructed by the firm of Schleicher, Schumm & Co., of Philadelphia, still occupies the first rank in America. As to the manufactures of other firms, differing from that type of engine, I need not pause to consider them here, but may refer the reader to the reports published on the subject in the Journal of the Association of German Engineers, by Schottler and Freytag,[1] and also to the report of Mr. Fred. H. Shelton.

The main cause of the remarkably restricted use of gas engines in the States is generally supposed to be the disproportionately high price of gas engines in comparison with the price of steam engines, which, it must be confessed, is unusually low in America. In Germany gas engines are in all cases, almost without exception, cheaper than steam engines, especially when the cost of the boiler is taken into account; whereas in America the difference is the other way, gas engines being from 2 to 4 times more expensive.

Just as Montreal, Canada, was the only city in which I found the new Auer burner being energetically pushed, so San Francisco, on the Pacific Ocean, in the extreme "Far West," was the only place where, mainly owing to the energetic efforts of the President of the San Francisco Gas Light Company, Mr. J. B. Crockett, and to the existence of works in San Francisco in which the construction of cheap gas engines is a kind of specialty, the employment of gas engines is almost as general as with us in Germany.

The prices of gas, as supplied for motor engines, fluctuate, as in Germany, between 12 and 15 pfennigs per cubic meter, while the motors themselves, in America as well as with us, generally do their work at less cost than electromotors.

The recognition of the fact that gas engines in America as much as anywhere else are destined to play an important part in the future, seems, however, to be shared in by all the authorities whom I had occasion to meet; and a significant circumstance in connection with this question is that, at the present time, even the well-known dynamo works of Westinghouse in Pittsburgh are taking up the construction of gas engines with great energy. The vertical gas engines, which they build in a style very similar to their twin "Hammer" steam engines,[2] may be coupled with the dynamo direct, the management taking the perfectly correct view that in a great many cases it is hardly possible to fit up an electrical station more simply than by providing gas-driven dynamos, especially where space is an object, as it generally is in the busy parts of American cities, with their tower buildings.

The employment of gas engines in propelling street cars has been tried in America as well as in England and with us. Thus, in a northern suburb of Chicago, I came across a locomotive engine driven by gas and constructed on the well known Connelly system, which has been repeatedly described in technical journals. The locomotive engine, with a car coupled to it, was being run by way of trial for the distance of about one mile. The engine had originally been constructed to be worked by naphtha, but at the time I saw it it was being fed with oil gas (not coal gas), because there happened to be an old oil gas works at the Company's disposal, so that the better and cheaper plan was for the Company to make their own oil gas instead of purchasing coal gas. The particular gas operated car, which was being worked at the time, did not, indeed, give entire satisfaction; but the contemplated improvements, which were then being devised by Mr. Lynch, seemed to promise a fair measure of success for the future, also to this system of independent locomotive engines driven by gas.

What the street car company, which has bought the Connelly patents for the State of Illinois (being styled the Connelly Motor Company, of Illinois), contemplates doing after the new improvements having been successful, is to replace the existing tram cars by gas driven cars upon the so-called "feeders"—*i. e.*, the lines radiating from the outskirts to the busy center of the town. And this is a very rational plan, and one that goes to show that cars driven by gas engines may be combined, or made to co-operate with cables and tram lines or trolleys. A further outlook is to introduce gas-driven cars into smaller towns in which the sparseness of the population did not warrant the employment of electrically operated or horse drawn tram cars.

A feature of American street life most interesting to observe is to see, side by side, tram cars drawn by horses, moved by cables, and driven by electricity or steam. But notwithstanding the great success with which the so-called "trolley" system has undoubtedly met hitherto in America, the latest street car line which was opened in the city of New York, while I was staying there, was a cable line; and this system also predominates in Chicago, absorbing the greater part of the traffic of that city. What accounts for this condition of things is the fact that the serious inconveniences resulting from the numerous overhead lines had not then been long obviated in New York. It must be admitted at the same time, however, that the cable method of locomotion has not, any more than the other existing means of conveyance, so far proved capable of quite satisfactorily coping with the dense traffic; and, in order to show that none of the street car arrangements now existing in America appear to be sufficient to the most eminent and authorized persons, engineers or official authorities,[1] I would hereinafter quote a few passages from a most interesting letter, addressed by the Metropolitan Traction Company—the Company which runs the New York street cars—to the Board of Railroad Commissioners, and which was published in the issue of the New York *World*, dated the 5th December last.

After having stated that the cable system recently fitted up is chiefly suitable to apply to street lines, the letter goes on as follows:

"The sole question is: What motive power can here be substituted to mutual advantage and satisfaction? We desire to hasten the development and completion of such an improved system by the offer of an immediate reward which would encourage such a concentration of energy as to bring about quick results.

"We therefore submit to you the following propositions:

"*First.*—We will set aside the sum of $50,000 to be awarded as a prize to any person who shall, before March 1st (1894), submit to your honorable board a system of motive power for street railway cars, demonstrated to be superior or equal to the overhead trolley.

"*Second.*—The qualities necessary to meet this requirement shall be left to your decision; but with the present state of the art, a system, to win an award, must necessarily approximate to the trolley system—*i. e.*, the electrical railway with an overhead supply of current, as a standard of economy of operation, but should be without the features thereof objectionable to the public."

Gentlemen, I am not aware whether it was possible for the Connelly Gas Motor Company to take part in this competition prior to the period of March of this year. Indeed, I do not know whether that competition has taken place; but, judging from the general requirements as stated by the Metropolitan Traction Company, in the letter offering the prize, it seems quite possible that a gas motor system may be one of the many systems by which the problem can be solved. Such, too, was probably the view of my courteous American colleague, Mr. Fred. Egner, who very kindly sent me the newspaper cutting in which the letter offering the award was quoted. The possible solution may lie either in the direction of the construction of a separate locomotive engine, driven by gas, with the carriages attached to it (on the Connelly system), or it may assume the form of a motor engine directly joined to the passenger vehicle (on the Luhrig system, of Dresden, which the London Gas Traction Company carried out with many improvements.) This system of the London Company, to my mind, shows that Germany and England are, in this respect, in advance of America. It is to be hoped that the first public gas car service established at Dessau this year, with nine gas motor cars to cover two lines of a summary distance of 4.4 kilometers, may not be a failure.[2]

Be that as it may, and no matter which of the existing or future gas car systems may be adopted in preference, both the judgment of many intelligent American engineers, and the letter partly quoted above, warrant the conclusion that among the many methods of operation which will have to be called into requisition to supply the growing want for street car accommodation, the gas motor system is sure to have its place assigned to it both in America and in our own country. This system, indeed, combines in an almost ideal manner all the advantages characteristic of both centralization and decentralization; since, in fact, the production of the driving medium on a large scale is centralized in the existing gas works and pipes, whereas their actual operation of the driving power so produced is decentralized, somewhat in the manner which constitutes the ideal of many electricians—each car being provided with a light power reservoir or accumulator, which may, in

1. R. Schottler, "Zeitschrift des Vereins deutscher Ingenieure," 1891, p. 903.
F. Freytag, " " " " " " 1893, p. 1227.

2. See AMERICAN GAS LIGHT JOURNAL for 1893, Vol. LIX., p. 42.

1. Compare Riedler's "Light and Power Plants in Boston," which appeared in the "Zeitschrift des Vereins Deutscher Ingenieure," for 1893, p. 580; or as a separate supplement, p. 12.

2. See the lecture by Mr. Kemper, delivered at the Dresden Gas Meeting last year, published in the *Journal fur Gasbeleuchtung*, for 1893, p. 503; also the essay entitled "Some New Results of the Tentative System of Gas Motor Cars, Started by the Gas Traction Company," published in the "Zeitschrift fur Kleinbahnen," for 1894, No. 5.

various parts of the town, or at a certain point of the line, be refilled according to the requirements with fresh supplies of the driving medium, so that each car or its motor engine may conveniently be operated without having to depend on wires or cables for its supply of motive power. Besides, and this is a most important feature in street car traffic, the gas motor cars are remarkably light. The small car of the Dresden system, for example, which comes in operation at Dessau and which holds 20 persons, only weighs 4½ tons. On being once filled with gas this car will run for about 8 kilometers without requiring to be refilled.

With this I will conclude the series of my "instantaneous pictures" by which I have endeavored to illustrate the present state of the gas industry in America, in regard to the distribution of heat, light and power. In reviewing these sketches, I ask you, gentlemen, to bear in mind the fact that the development of American industry, in this as in other departments, has taken place under conditions peculiarly and essentially American, which we must not, without further notice, attempt to compare with the conditions of our industrial life at home. Therefore, while the Americans are, indeed, "behind the time," as regards the employment of the greatest invention in gas lighting of the modern times—*i. e.*, of Auer's new incandescent lamp—and behind the time in the general adoption of gas engines, and whilst we Germans have made more progress than our American friends in the manufacture of coal gas, especially in our methods of working generator furnaces,[1] we have, on the other hand, all the more reason to thank them for having thus far worked out the water gas manufacture, and having done so much of the preliminary work for us in that direction, and with such splendid results, thereby enabling us, almost without any risk, to embark in water gas manufacture at any convenient time, *i. e.*, whenever the carbureting agents available, or the improvements made in the incandescent burners, may permit us to do so, and to compare, or to combine, if we choose, American methods of operation with such European methods as may have been devised over here for the purposes of water gas manufacture. The service which they have rendered us in this respect cannot be overestimated when it is considered how rapidly things advance and mature in these "go-ahead" times.

Now, if I may be permitted, in conclusion, to make a few general remarks concerning the outward aspect of the American gas industry, I would say that, from what I have been able to gather, the position of that industry is as secure and as promising there as it is in any of the European States, and this is the more remarkable, and the more creditable to America, since the coal gas industry in that country has to keep up a keen competition with the kindred industries producing natural gas, mineral oil and electric light. A circumstance which is characteristic of the New World, however, where, generally speaking, industrial works assume such gigantic proportions, is that there can be found neither as large gas works as in England nor as extensive and beautiful electric central stations as in Germany. The main reason of this is probably the fact that a number of rival gas and electric companies are generally to be found at the same place, while with us and in England, from considerations of public conveniences, and on account of the existing condition of the thoroughfares, the usual thing is for one company, or indeed for the municipal authorities themselves, to monopolize the whole gas or electric supply of the place.

In regard to electric central stations, one main cause, in addition to the circumstances above mentioned, prevents these establishments from assuming gigantic proportions in America, and that is, the competition into which such central works have to enter with the many existing private installations, or what might be called an intra-industrial competition, owing to which establishments that would otherwise be among the largest and most desirable consumers of electricity—such as the large hotels, the enormous building occupied by offices or shops, the theaters, etc.—must be once and for all omitted from the list of probable patrons. As to private residences in America, they have not so far been supplied with electric light from a central station to an appreciable greater extent than with us.

Thus it will be seen that, so far as electric lighting goes, the customary American system of doing things on a grand scale, is displayed, not so much in the central as in the local private installations. Those who wish to obtain further particulars regarding this point may refer to the valuable material, accompanied by diagrams and a profusion of details, which is given in those hurried and yet so wonderfully complete reports, sent in by Messrs. Riedler, Reichel and Gutermuth to the "Zeitschrift des Vereins Deutscher Ingenieure," and containing a vast deal of interesting information and excellent criticism.[2]

1. I only found one system of generator furnaces in use, and that had been imported from Germany (Klonne's system).

2. These reports were printed separately under the title "Maschinenanlagen und Ausnutzung der Naturkrafte in Amerika," by M. F. Gutermuth, E. Reichel and A. Riedler Berlin, J. Springer, publisher.

To mention but one example of such local or private installations carried out on a truly colossal scale, I will take the new lighting and heating plant fitted up at the Auditorium Hotel, at Chicago, and which is arranged for as much as 20,000 incandescent lamps, and has 1,750 horse power at its command. In fact, the installation in question is very nearly equal to the Dusseldorf Electric Works in extent; and I may add, by-the-way, that in the selection of dynamos our Siemens & Halske dynamos were adopted in preference to the American machines.

I also feel that I must not omit to refer to a question which, since my return, has been frequently addressed to me, by both experts and laymen, viz., "What is the position of American gas works in regard to their dividends? Are those still capable to compete with electricity developed in that country to such a high degree."

A clear and concise answer to this question will be found in the following table:

A Table of the Average Profits Realized by the Gas and Electric Light Works of Massachusetts. Area, 21,000 square kilometers; population, 2¼ million, or 104 inhabitants per square kilometer. (Germany has 91.4 inhabitants per square kilometer.) Capital, Boston (450,000 inhabitants). These items have been collected from official returns.

	Years.	Number of Companies whose Financial Status appears in the Returns.	Number of Companies by which no Dividends have been Paid.	Maximum Dividends Paid.	Average Dividends, all Companies Included.
Companies supplying gas only.	1886*	62	* 10	36 p. ct.	7.58 p. ct.
	1887	64	11	22 "	6.97 "
	1888	64	12	20 "	6.86 "
	1889	61	11	20 "	6.92 "
	1890	48	13	20 "	5.82 "
	1892†	45	12	20 "	6.37 "
Companies supplying electricity only.	1889*	15	1	21 p. ct.	6.36 p. ct.
	1890	22	—	10 "	4.86 "
	1892†	58‡	35§	8 "	2.27 "
Companies supplying both electric light and gas.	1889	18‖	2	18 p. ct.	7.20 p. ct.
	1890	23‖	7	10 "	5.00 "
	1892	25	8	10 "	4.54 "

* Years in which the profits of the Companies were first stated in the returns.

† As to 1891, no returns came into my hands.

‡ All these Companies were of at least two years' standing at the time of issue of the first returns; the oldest were formed as long ago as 1882; most of the others in either in 1886 or 1887.

‖ Out of these 35 Companies, 1 existed since 1884, 10 since 1886, 8 since 1887, 9 since 1888, 4 since 1889, and 3 since 1890.

§ The returns do not show whether, at the time, all of the Companies were supplying electric light already.

The average profits of the Edison Electric Illuminating Company, of New York: 1891, 4 per cent.; 1892, 5 per cent.; 1893, 5¾ per cent.

This table has been compiled from the returns of the Board of Gas and Electric Commissioners of the State of Massachusetts. This State extends over a large portion of the tract of land where European culture first made its appearance in North America. Its population stands second in order as to density, and its capital is the wealthy city of Boston. For all these reasons, and also because the data, which have been derived from official sources, are based upon the comparison of a large number of gas and electrical companies, the figures given in the table may be said to be particularly significant and instructive. They show that the average profits of the gas companies from 1886 (*i. e.*, the time of issue of the first report of the Commissioners) to 1892 (the last report that was forwarded to me) had been subject to but very slight fluctuations, the average dividends paid having been 6.75 per cent.; while as regards the electrical companies the average dividends, which amounted to as much as 6.36 per cent. in 1889, came down to 2.27 per cent. in 1892, in proportion as the number of central stations increased, so that their receipts in the latter year scarcely exceeded one-third of those of the gas works. The companies which combined both gas and electricity have also experienced a very material falling off in their profits, the average dividends having sunk from 7.2 per cent., in 1889, to 4.54 per cent. in 1892.

Yet, in New York, owing to the exceptionally favorable conditions prevailing in that city, the dividends of the Edison Company appear to have gradually risen from 4 per cent. in 1891 to 5¾ per cent. in 1893.

But owing to the fact (already alluded to above) that American consumers of electric light depend more on local installations or branch es-

tablishments than on central stations for their supplies of electricity,[1] the general development of the electrical industry is scarcely, if at all, affected by the smallness of the dividends of the central supply companies, but steadily and surely advances and grows; but so does also the gas industry, which certainly shows no signs of weakness or flagging. As a striking illustration of this I may mention Minneapolis, a busy, fast-growing town, which has already left its twin city, St. Paul, behind it, and the rapidity of whose advancement seems remarkable even if viewed in the light of American notions. In Minneapolis, then, last year's returns show an increase in the consumption of gas, amounting to 37 per cent., while before any central electrical works had been created there the increase in the gas consumption represented only 20 per cent. Thus, within a period of nine years (1883 to 1892) the consumption of gas in that town had increased fourfold. This remarkable development is, to a very great extent, due to the energy with which the Minneapolis Gas Company has pushed the introduction of gas into general use for cooking purposes. Besides, our Minneapolis confrere informs us that 75 per cent.[2] of all the electrical incandescent lamps of the town are fed from local installations, while the arc lamps are supplied with electricity from a central establishment.

The prevailing confidence in the future of the American gas industry was further evidenced by the numerous new constructions of gas works which I found all over the country. Taking some of them, I may mention the Calf Pasture Station, Boston; the new works at Newark, N. J.; Cleveland, Ohio; Denver, Colorado; and San Francisco, Cal. But perhaps nowhere was that confidence more palpably manifest than in Long Island City, where the recently created East River Company is erecting the first really gigantic American gas works for the manufacture of water gas on an enormous scale;[3] and whence it is intended to conduct the gas to New York, through a special large tunnel built at a considerable depth below the bed of the East river. In New York the gas is, in the first instance, to be supplied to the consumers direct, while, later on, it may be sold to the old gas companies, when their own grounds within the city become insufficient to cope with the growing demand.

And when these facts, which show how very firmly the future of the American gas industry is believed in by the native population, in spite of the enormous competition that has to be confronted; when to these evidences of security, I say, are considered side by side with the state of things existing, not only in New York, but in nearly all large American cities, where (as in Pittsburgh, Pa., for example), in addition to a large natural gas company, there exist four other Companies producing artificial gas, to say nothing of a number of electrical concerns, nor of the large quantities of mineral oil that are consumed (such oil being obtained in the immediate vicinity); taking these facts into account one cannot help smiling at the narrow view which is still widely entertained with us in Germany, even in authorized circles, viz.: That man's numerous and infinitely varied wants, as connected with light, heat and power, may some day be all supplied by one individual industry; that, therefore, several kindred industries may not long continue to exist together, but that the one is bound sooner or later to supersede all the others and to come out alone and victorious from the bitter struggle. Possibly the report of such facts as gathered in this paper may to some extent assist in gradually dispelling such preposterous notions.

Lastly, I should not like to take leave of America, even figuratively, as I am now compelled to do, without once more communicating to our American colleagues a word expressive of our sincere thanks for the great courtesy which they were pleased to show us, Professor Bunte and myself, traveling at different times, not only by acquainting us with all the ins-and-outs and peculiarities of the American gas industry, but also by giving us other opportunities of becoming familiar with their highly interesting and in some parts incomparably beautiful country. Whenever we had a little time to spare they were not content merely to show us over works or industrial concerns, but very kindly acted as personal guides for us both in town and country, at the same time inviting us to their clubs or their family circles, and giving us introductions to their friends as we traveled from place to place, never ceasing the while to exhibit a genial willingness to inform and instruct us on all and every subject we might happen to be interested in.

Gentlemen, I know that Germans are not incapable of emulating the hospitality, however generous, that is practiced on either side of the Rocky Mountains; and I confidently hope that if we should some day have the good fortune to welcome our American friends over here, they, too, may, upon their return, have reason to preserve a grateful recollection of their stay in Germany.

1. The same remark appears to be applicable to Germany, according to H. Bunte and Dr. Rasch's joint report entitled "Statistical Data as to the Extension of the use of Electric Light Within the Domain Hitherto Controlled by German Gas Works" (published by Friedr. Gutsch, in Karlsruhe.) These data show that the proportion of the lamps fed from central electrical stations in Germany does not exceed 25 per cent. of the total number of lamps lighted; and further, that a German town (Leipzig) uses the greatest number of electrical lamps, in proportion to its population, although no central supply of electricity whatever has been hitherto provided in that city. (See the memoranda read by Dr. Rasch to the Gas Meeting held at Karlsruhe this year.)

2. This is just the same proportion which is stated by Bunte and Rasch as an average for Germany.

3. Aggregate yield arranged for: 24,000,000 feet (or 680,000 cubic meters) per diem. First plant capable of turning out 6 million feet or 170,000 cubic meters per diem.

Supplement.

Average life of the mantles used in Auer's incandescent gas lamps, as experienced in the gas works of the Deutsche Continental Gas Gesellschaft:

When the new incandescent gas light first made its appearance, the Director-General Fahndrich, of Vienna, put the average life of the mantles employed at only 350 hours; while in reporting in Berlin the results of our experiments at Dessau, I took the following figures as a basis, viz.: When considering the illuminating power, the average life was taken as 500 hours, and when considering the comparative cost, the average life was taken as 150 hours (that is to say, 4 incandescent bodies or mantles for every 600 hours).

The reports issued from the several gas works of the Deutsche Continental Gas Gesellschaft, in the months of February and March of the present year, and covering a period of practical working of over a twelvemonth, bring out the following facts:

In those establishments where the information had been most carefully collected—those of Erfurt and M. Gladbach—the average life of mantles used in Auer's incandescent burners was as follows:

In appartments	500 to 600 hours.
In shops	530 to 650 hours.
In restaurants and offices	650 to 850 hours.

In reference to the other works, no such practical data had been obtained, and, accordingly, the average figures given were, upon the whole, somewhat lower. At all events, as has been justly observed by one of the oldest managers in the Deutsche Continental Gas Gesellschaft, "The durability of the incandescent bodies or mantles mainly and primarily depends on the manner in which they are treated." We therefore have no doubt that, as the attendants gain experience, and grow more careful in dealing with these mantles and supervising their operation, it will be possible, in course of time, to still further raise their general standard of duration. In fact, among the number of hours recorded up to the date of the present report, and representing the time for which the mantles had, in actual practice, been kept lighted, there appear, now, such figures as 1,534, 1,820, and 1,957, while figures nearly as high as these, and even higher, are reported to have been attained within the practical experience at other German gas works.

A fact worthy of special notice is, that the lamp which continued burning for 1,957 hours (from Nov. 17, 1893, to April 20, 1894) was unprovided with any regulator, and was subjected to varying pressures, fluctuating between 70 and 80 mm. at night, and between 45 and 65 mm. during the day, which circumstance induced the very painstaking, cautious and observant writer to add to his statement this general remark:

"High pressure both enhances the luminous effect and renders the incandescent bodies or mantles more durable, being, therefore, preferable even from an economical point of view."

With regard to the length of time during which a luminous body or mantle of this class will remain fit for use in lighting streets or places of public resort, no positive data that may be relied on have so far been obtainable, seeing that the number of hours during which combustion may be kept up for this purpose is apt to vary within very wide limits, according to local circumstances and to the mode of fitting adopted (for example, according as the illuminating bodies or mantles are fitted in chandeliers or brackets); but as to the eventual introduction of these lamps into use for street lighting, there appears, even at the present moment, to be no doubt whatever. Besides, the figures which have been communicated to us by all the establishments of the Deutsche Continental Gas Gesellschaft are, in themselves, quite sufficient to show conclusively that the final and permanent adoption of the incandescent gas light, and still to a greater extent to which it has been hitherto, is a matter beyond question. Any further progress that may be made in the methods of its production will, of course, be heartily welcomed, and in this connection it may be mentioned, as a matter for regret, that a certain incandescent body or mantle, which was entirely new and possessed considerable firmness, was submitted to some of the visitors of the Karlsruhe meeting too late to be thoroughly examined by them.

Photometry.

[The first of a series of lectures delivered before the British Society of Arts, by Capt. W. de W. Abney, F.R.S.]

These lectures on photometry are not given with the idea that they will be of practical value for the measurement of gas light. There is excellent literature on the subject, part of which I shall have to refer to during my course. What I have undertaken in these lectures is to endeavor to give an idea of the general principles of photometry, almost restricting myself to the scientific aspect of the question. Photometry, in its broadest sense, is the measurement of light, at least, so we must think, from its derivation. Now, the light measured may be light coming from an object, or from a self-luminous body, such as a candle or the sun, or it may be the light transmitted through objects. In the second case, if an appropriate screen be used to receive the light, we are in reality measuring the illuminating power of the source of light, rather than of the light itself. Hence, almost as much depends upon the screen on which the light is received as on the light itself. A screen is usually what is called white, and by white is meant a screen which reflects every color equally well; but, I would remark that in London the white may become imperceptibly brown, and such color may interfere materially with accurate results. But the photometry that I am alluding to not only includes the measurement of the illuminating power of light, but the measurement of the light transmitted through bodies of various kinds, when they are transparent, like plain glass, or translucent, like ground glass or paper. The requirements of the candle power of gas I shall not enter into, as it is a subject which others than myself are much better fitted to deal with.

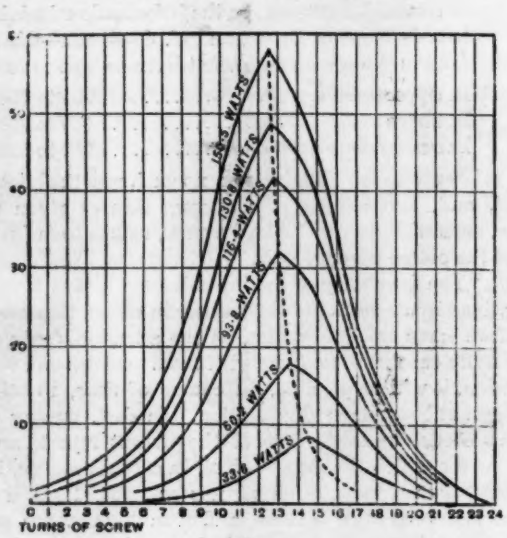

Fig. 1.

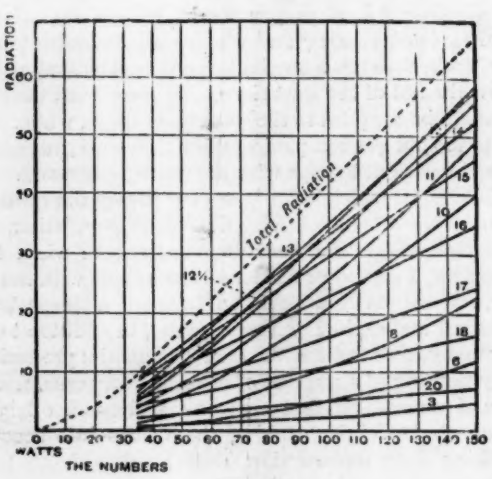

Fig. 2.

We may take it, I think, that the first matter we have to consider is the light we have to use as a standard. Parliament, in its wisdom, in 1860, pronounced its standard of light to be the light of a candle 6 candles to the pound, each burning 120 grains of sperm per hour, and this is at present the only legal standard known in England, though why, in the name of common sense, such a definition has been continued our legislators alone can guess, when it has been proved to be so faulty. The standard of light for France is the Carcel lamp, which is equal to about 9.5 candles. Now, a light from a candle is a very pretty thing theoretically, but practically it is anything but practical, as it has the unhappy knack of burning inaccurately, particularly when one is anxious to shield it from draughts. Heat affects the rapidity of combustion, and if it be confined, and no proper access of air be given it, its light may be most irregular. We have to remember that part of the energy of combustion is taken up by melting the sperm, or wax, or whatever it may be, and if the surrounding air be heated the wax is at a temperature nearer its melting point than it should be when at a normal temperature.

When the melting point is attained the liquid is decomposed and the flame results, and there is more liquid to be vaporized and vapor to be improperly consumed than in the normal state.

I show you a trace made by photography of the light from a candle burning under normal conditions. The light was admitted through a slit to sensitive paper, and a fresh portion of paper was continually being exposed. You will now see the irregularity of the burning. Of course, by taking several candles the variation is not so great, but even then you have to be sure that the proximity of the candles to one another does not alter the rate of burning.

An Argand burner, however small, will not, during a long series of experiments, differ 1 per cent. in light value. Here we have a proof of this. This small paraffine lamp was allowed to burn for three hours, and you will see that the band it makes is perfectly uniform in appearance, and when the measurement is made of the blackness produced by it on the photographic paper, it proves my statement is correct.

The apparatus by which these diagrams were made is a very simple one. It consists of a clockwork arrangement drawing a pulley, which pulley is in connection with a drum, which can rotate on its axis. Round this drum is placed sensitive paper, and a box, with a long slit in it, covers the drum. The light is placed opposite the slit, which is covered by a movable lathe, in which is an aperture of a convenient width. As the drum moves, this aperture moves across the slit, and so we have a corkscrew band of exposure produced. With some clockwork the motion is regular in its irrregularity, and every tooth of the train can be counted on it, by noting the bands of varying exposure, and for this reason the clock was at one time abandoned, and the smooth motion of the sinking of the height in subsiding water was substituted. This gave very good results, but for my purpose the clockwork was sufficient.

The sources of light I have mentioned are what may be called feeble sources of light, and cannot be used when a body is fairly absorptive, if the transmitted light is to be measured. We want in such a case a stronger source of light, and one which is practically constant. Such a source of light we have in the electric arc light. If we project upon the screen an image of the points where the positive pole is slightly behind the negative pole, with a fairly long arc, we become aware that there is a central part, which is higher than any other [shown]. It comes from a depression in the positive pole, and for the last eight years I have been in the habit of using this as a source of light of uniform intensity, and many hundreds of measures have proved it to be so. This, as several years ago I pointed out, was due to the fact that the temperature of this spot was that of the volatilization of carbon. It is an intense light, and may be taken as 50,000 A.L. per inch of surface, and very useful for a great many purposes, as we shall see as we proceed. Now we call all these lights which I have mentioned white, but it is quite evident that there is white and white if all these be white. I believe myself that Mr. Lovibond's definition of white is a good one, which is the light which is seen in a white fog about midday, and if we compare this light with any other we shall, I think, come back to it as being a very practical white light. Now the electric light is not far from this quality of light, and as such is very useful in comparing the transparency of objects by what is approximately daylight. We can measure the light of each part of the crater passing through a small hole.

We can at once see the difference between all the ordinary lights by a simple experiment. This box is divided into partitions with tissue in front, and in each partition we have a different source of light—a partial gas jet, an Argand gas burner, a candle, and a paraffine lamp. It will be noticed that the light inclosed in a chimney is much whiter than those burned in free air, but you will also see that all these lights have various depths of yellowness when compared with the electric light. It is quite evident that even supposing they gave the same illumination, that they are not all fit for standard lights. I take it that a standard

light in photometry must always have the same quality of light as well as the same quantity of light. Now we can, by appropriate means, make the electric glow lamp light of the same visual intervals as a gas jet. The one before us is so, but it is evidently not of the same quality. One of the very best tests that we can make of ascertaining whether any difference in quality exists is to see if, when they are equally strong visually, they give the same photographic results. [An experiment was made with an electric light and an amyl acetate lamp, in which both were made of the same visual intensity, but photographically they differed materially.] You see that the amyl acetate lamp is decidedly the worse photographically.

Perhaps I can show you why this is. I take an incandescent lamp, and cause it to glow; it goes red, to begin with; then I increase the current, it gets yellow, then whiter, and so on, till it is nearly white. I cannot make it as white as the arc light, for the reason that, as the temperature increases, the fusing point of carbon is reached, and that, as I pointed out, is the temperature of the crater of the arc light. These temperatures, however, are subject to different amounts of energy expended upon them; and here I have a diagram, showing how, with an increased energy expenditure on the same filament—that is, with an increased temperature—the different rays of the spectrum are altered in proportion. These diagrams are taken from measures made with a linear thermopile, moved through the spectrum. You will see that the higher the temperature, much more rapidly do the rays of high refrangibility increase.

The value of the abscissæ in Fig. 1 (in wave lengths) is as follows:

1.25	5,900	13	14,650
5	7,250	17	20,750
9	9,900	21	27,500

These numbers apply to both diagrams, and in Fig. 2 the numbers attached to the different curves are those which are attached to the abscissæ in Fig. 1.

Let me show an experiment. I will balance an electric light against the amyl acetate lamp, and expose a piece of paper to its action. I will increase the temperature and balance again, and expose another portion of the same paper to its influence for the same time. Notice, please, the difference in the two. You will find that the highest temperature filament is much more "photographic." By this means all lights, which are due to the incandescence of solid particles of carbon, can be tested as to quality. Make them visually equal, and then see if they are photographically equal. For my own part, I believe that a knowledge of the photographic value of light is essential in the near future, for I cannot help thinking that there will have to be a registration of photometric values for record, independent of the eye, and this must be by photography.

For this purpose the photographic value, and the visual value of every light used, will have to be known and carefully recorded. We shall see soon how these records can be utilized and become of permanent value in themselves, being capable of being measured at any date after being made, and remeasured if required. I throw on the screen the photographic values of a candle, an amyl acetate lamp, a gas jet, a paraffine lamp, and an arc light—all made of the same value as a candle visually [shown]. You will see that they vary enormously, and the scale of opacity below, which was made by exposing different parts of a plate to a steady light for different times, gives us a means of comparing one with the other.

I have said that all lights which are due to solid particles of incandescent carbon can be tested by means of photography, and I have shown you the deposits which certain lights cause on a photographic plate. There can now be but little doubt that a luminous candle flame is as much due to solid incandescent particles as the glow lamp we have been using. The final proof has been long in abeyance, but I think no doubt now can exist regarding it. First of all, if we examine the spectrum of the luminous part of the flame, we find that it is continuous, though occasionally a bright line of sodium in the orange puts in an appearance, but it is of no account. Now, any light which emits a continuous spectrum must be due to a solid or liquid body in a state of incandescence, or to a gas in similar state, but under great pressure. The flame is certainly not liquid, nor is it gaseous under pressure. It seems, therefore, the light must be due to solids, and those solids must be so small that even a microscope of low power will fail to distinguish them. This fact (if it be a fact) enables us to put the matter to a good test. If we project a beam of light against a cloud of small particles, the rays which are most refracted (the violet and the blue) are violently scattered in all directions, as Lord Rayleigh has shown should be the case theoretically, and the greater the number the more yellow is the light coming through them. There is one peculiarity, however, about these scattered rays, viz., that those which are scattered at right angles to the beam are what are termed polarized in one direction—that is, that if they pass through a Nicol's prism turned in one direction they become quenched, whilst they will pass through readily if the Nicol be turned in the direction at right angles. You will see what I mean by the scattering by an experiment which I now make.

If to this clear solution of the hyposulphite I add a few drops of hydrochloric acid, it becomes cloudy, owing to precipitation of fine particles of sulphur. I allow a beam of light to pass through the solution

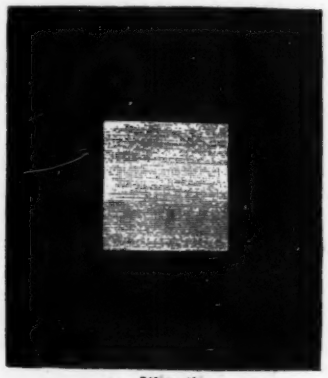

Fig. 3.

Fig. 5.

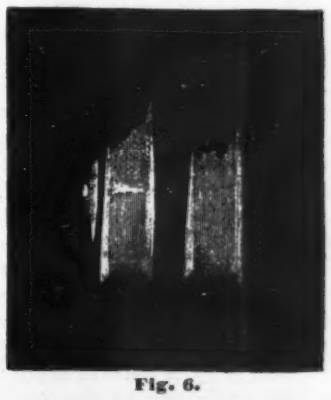

Fig. 6.

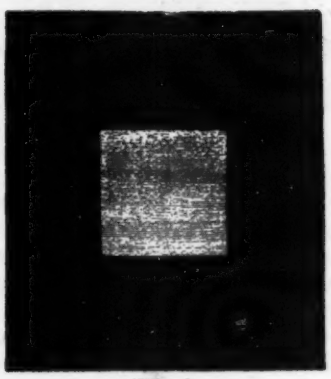

Fig. 4.

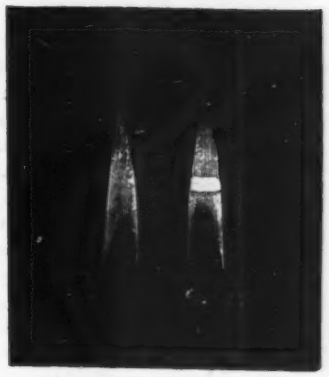

Fig. 7.

before I make the addition to the screen, and then add the HCl. The light becomes yellowish and then reddish, as the number of fine particles increase; that is, the more particles the redder it becomes, and the more light is scattered, as a look at the cell testifies.

By precipitating mastic in water we get the same results. Here is some which has stood two years or more, and while it is turbid the beam of light passes freely through it, but scatters light on each side. Now, if I pass that broad beam of light first through a Nicol's prism, turned in one direction, and then through the solution, the path of the beam is clearly visible, but if I turned it in a direction at right angles it is at once quenched. Its existence, in the first case, and its absence, in the second, shows that the light, coming at right angles to the beam, is polarized. This you can see for yourselves, at least most of you who sit in the proper direction; but for the sake of those who do not I take two photographs, one with the Nicol turned, so that the polarized light passed, and the other when it was turned, so as to present the beam. You see the result.

Now let us apply this to the small carbon particles. If a beam of intense light, such as that coming from a small image of the sun, be thrown on the flame of a candle, a white beam of sunlight should be seen on the flame, and a beam of white light passing through the flame. Unfortunately, I have not the sun at my command here to-night, so I cannot show it, but you may take my word for it that such is so. Sir G. Stokes examined this white beam in a position at right angles to its direction, and found, by means of a Nicol's prism, that it was completely polarized; that is, that when the Nicol was turned in one direction, the streak of white light in the flame disappeared altogether. This establishes the fact that the luminous part of the flame is due to small particles, independently of any other proof. It appears to me, therefore, that one is correct in stating that the bright flames are due to measurement carbon. Into the theory of flames I will not further enter at the present time; this is enough for my purpose.

In case there be any doubt amongst you, I will show you some photographs of the phenomena I have taken.

Fig. 5 is a photograph of an Argand gas flame, on which the rays of the sun, collected by a lense of about 8-inch focus, were concentrated so as to pass along part of the circumference of the cylinder. The Nicol prism was turned in such a direction that the scattered rays would be unaffected in the left-hand photograph, whilst it was turned at right angles to the first direction for the right-hand photograph. In the left-hand figure the track of the beam is readily seen, whereas any trace of it is absent in the right-hand figure. Fig. 6 is the same, but the electric arc light was used in place of the sun. The results are the same.

Fig. 7 shows the results when the beam from the electric light is passed through a candle flame. In the one figure a broadish white band is seen, whilst in the other it is absent.

We are now in a position to see why it is some flames are whiter than others. When a chimney is used with gas, for instance, we find that the illumination is whiter—bluer, if you like the word better. The function of a chimney is to supply air to the flame, ample room being found through interstices to allow as much air as is needed to be drawn up into the chimney. In the case of hollow flames, such as an Argand burner, not only is the air admitted to the outside shell of the flame, but also to the inside. The consequence is that the small particles of carbon are heated to a higher temperature, as they are in the blacksmith's forge by the bellows, and they then emit a whiter heat before they are converted into carbonic acid. When one has a smoky lamp there is one of two things happening—either the supply of air is insufficient to the chimney, or else the flame is too high and the sudden access of cold air chills down the incandescent carbon particles till they become black, and smoke results. One of the most instructive experiments as to the need of air and warmed air to a flame is shown by lighting a paraffine lamp. It is an orange smoky flame, but directly you place the chimney on it the light whitens and the smoke ceases.

I should here like to correct a very common notion which exists regarding the blackening of ceilings by gas flames. As a matter of fact, the carbon in a gas flame ordinarily is totally converted into carbonic acid. It is the ascending current of heated air that catches up the floating motes in the room and dashes them against the ceiling, to which some cling tenaciously, and gradually the blackening is encountered. A friend of mine lately put up the electric light in his house, and placed the glow lamps close to his ceiling. He was astonished to find that the ceiling above them blackened to an extent which reminded him of gas. It was the current of warm air which caused the blackening. Similarly, hot water pipes will do exactly the same thing. Heated air will ascend, and when it ascends it carries the motes and particles with it. In South Kensington Museum, ceilings which adjoin hot water pipes blacken quicker than where there is gas, the reason being that the volume of heated air is so large.

[To be continued.]

SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, Aug. 10, 1894.

An Important Question as to Gas Mains.—The Peebles Process.—Gas Making Fifty Years Ago.—The Coal Trade.

The Kettering Gas Company have successfully contested, in a court of law, an interesting and important question as to the rights of gas companies in respect to their distributing plant. They sued a local builder for damages sustained in consequence of the displacement of a gas main, as the result of excavations carried out in making a sewer. Their case was that a length of gas main had been laid along a certain road some 18 years ago, and up to the period when the ground was disturbed for the laying of the sewer, had proved perfectly sound; that the defendant, having occasion to lay a sewer nearly in the same line with, but at a lower level than their main, removed the ground beneath it and did not properly support the pipe, or sufficiently ram the soil when filling in; as a consequence the earth sank and the gas main sank with it, causing the separation of a service pipe therefrom and a loss of gas. In defence, the charge of carelessness or negligence in filling in the ground was denied; an attempt was made to show that the pipe was supported; and the damage complained of was attributed to the use of a steam roller. After hearing the evidence and the statements of counsel, the Judge said the case was clear in law and in fact. The Company, having the duty of supplying gas imposed on them, were not tresspassers in the road. Therefore anyone putting in a sewer had no right to injure the gas pipes, and whoever injured them must make them good. In the present case there had been negligence. Probably instructions had been given to the workmen to have the pipe properly supported, but the person who gave the instructions did not see them carried out. The main had not been properly supported at the point where the subsidence occurred. The injury being due to the neglect of the defendants' workmen, judgment would be entered for the plaintiffs. But he hoped that they would not ask for costs, now that they had asserted their rights.

The arrangement of apparatus for making gas that has lately been introduced by Mr. William Young, and has acquired the title of the "Peebles process," has lately attracted a large share of attention. Since its inauguration it has been continually in the front. Somebody has had to report on it, or is going to adopt it, or, having tried it, desires to publish the results. Two papers bearing upon it were read and fully discussed at the recent meeting of the North British Association of Gas Managers, the first dealing with the practical results of enriching gas by its means, as attested by Mr. A. Yuill at the Alloa gas works, and the second consisted of an exposition on "Further Developments of the Peebles Process," and was contributed by the inventor. Mr. Yuill's testimony is of a highly satisfactory nature. It is based on a year's working, with a make of something over 40 million cubic feet of gas. The gas was thoroughly permanent, the coldest weather having but little effect on it, and the cost of enrichment is stated to be less than one farthing per candle per 1,000 cubic feet. The further developments referred to in the second paper are of an important character. The principal features of the process, that of continuous distillation until nothing but permanent gas and hard coke (or pitch if preferred) remains, and the securing of a perfectly permanent gas, are generally understood. Hitherto it has been applied only as an enriching process, for the production of a very high power gas, too rich for use in an undiluted state, and has been confined to the use of externally heated retorts. But now Mr. Young has adapted it to the actual production of the whole bulk of gas, and to the internally heated or cupola system, with alternate runs and blows. So that, if the hydrocarbon fluid used contains a sufficient excess of carbon, it is possible to convert it entirely into permanent gas with no residue whatever, and that without the aid of other fuel. The excess of carbon is deposited in the cupola in a solid form, and is disposed of by combustion during the heating up. Since the reading of the paper some elaborate and lengthy specifications from the Patent Office have been published, from which it appears that in addition to the arrangements above indicated, Mr. Young has also evolved a plan for dealing with the tar as produced at coal gas works with the ordinary retort system. He utilizes the existing retorts, and by slight and unimportant additions that can be fixed without interfer-

ing with regular working, he uses up the whole of the tar, converting it into gas and coke.

This looks like the dawn of better things for gas works managers. No pitch in the pipes, and no tar, to say nothing of the shadow of no residuals at all to deal with. All these things must be got rid of, or sold, or worked up, which in any case means a lot of trouble. So perhaps the time will come when gas managers will deal principally with making and selling gas, instead of leaving the principal thing to take care of itself, or receive just so much attention as can be spared from the multitude of etceteras that now absorb the bulk of our attention. And with that the manager of a medium sized gas works may look for the prospect of a reasonable annual holiday, like other people have.

It is not an uncommon thing to meet with assertions to the effect that the gas industry has not improved to any appreciable extent during the last 50 years. More gas is made, but simply by enlarged patterns of the old type, and not, it is claimed, by improved apparatus. Persons who advance such statements will have to rub their eyes if they happen to read a short article on this subject that has just appeared in the *Journal of Gas Lighting*, in which the working results obtained 50 years ago, such as make per ton, make per mouthpiece, and so on, right through to the duty per foot of gas burnt, are compared with similar items as in vogue at the present day. But unfortunately the originators of such statements are not likely to read current technical literature, as a careful study of facts is not in their line. The statement is put forth as a convenient support for some passing line of argument or policy, and is uttered in that connection rather than on account of conviction as to its truth. It is easy to make a broad assertion, as in all probability no one will trouble to controvert it, and if any person does show it to be wrong, there is plenty of resource remaining. His motives can be questioned, or he can be overwhelmed with personal abuse or sarcasm. Although every well read gas engineer is acquainted with the facts set forth in the paper just mentioned, it may nevertheless be commended to his careful attention ; and as for outsiders, we may hope it will be reproduced for their benefit in some of the popular periodicals. The most effective point made by the author is when he compares the state of scientific and technical knowledge that prevailed in the "forties" with our own time. Our knowledge of gas analysis, technical chemistry and other things that were absolutely unknown 50 years ago, might have been noticed at greater length.

The Conciliation Board, which was appointed under the auspices of the Government some six months ago, for the purpose of bringing about a better state of things in the coal trade, have scarcely justified the title, as their proceedings have not been notable for a peaceful spirit, and some weeks elapsed before they could agree upon a chairman. We have it on the best authority that a man should be capable of well ordering his own household before he can be considered a fit candidate for a certain important office ; and in a similar manner it follows that, if the Committee in question are to exercise any really beneficient influence on the numerous and conflicting interests which go to make up the coal trade, the idea of conciliation should be in strong evidence through their proceedings. The title was not intended for ornament, but as giving a tone to the whole thing. After a length of time that testifies silently but none the less powerfully to the difficulties in their way, they claim to have effected an agreement between employers and employed, which some suppose will have a steadying influence on the coal market. How far the parties concerned are inclined to respect the decisions of the Board is an uncertain matter, and it is only safe to say that they will be observed so long as the state of affairs in the coal market renders it desirable to do so. Since the year 1888 the wages paid to miners have been raised no less than 40 per cent., and the agreement provides that a reduction of 10 per cent. shall be made on August 1st, and continue in force till January 1st, 1896. But it gives a concession to the labor party that is cheaply bought at the price, viz., that no reduction is to be made, but a higher rate up to 45 per cent. on the 1888 rate may be paid. This virtually concedes the principle of a "minimum," or, as it has been speciously termed, a "living" wage, for which the labor party have been so long contending.

It is extremely improbable that any purchaser of coal would desire that the worker should be stinted in wages, or that the capitalist should not receive a reasonable interest on his investment. But at the same time he has a right to be considered in this matter of wages and profits. So far as the present state of the market is concerned, there is no difficulty in running contracts on fair terms, notwithstanding the little diversion of a strike in Scotland. This continued striking first in one district and then in another, seems to be a part of the regular programme. But the experience of last winter has shaken public confidence, and no one attaches overmuch importance to agreements that afford loopholes on either side. It is worthy of remark that the agreements in the coal trade are little if any more favorable to the purchaser than the disagreements. They all move towards maintaining and increasing prices and controlling the markets. So that either in case of unavoidable causes, such as cold weather, which increases the demand for coal, or artificial causes such as a strike, which increases demand by diminishing supply, the sales can be worked to the best advantage. A contract with a strike clause, which is now intended to cover stoppages at the pits irrespective of the cause, whether voluntary or compulsory, is really like the play of Hamlet with the chief character struck out. The contract will be observed—if it pays to do so. It is really time that bodies situated in the position of gas companies, who have been placed under rigid legal obligations that cannot be met in the absence of a proper supply of coal at a fair price, should have something to say in the matter. The government helps the wage earners to look after their interests, apart from the usual unions and federations. The capitalist knows well how to take care of himself. But who looks after the rights of the purchaser ?

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

MR. A. C. CLEEVIS is figuring on the establishment of a gas works at Tampa, Fla. His present address is "The Wigwam," Indian Springs, Georgia.

THE American Champion Gas Fixture Company, to manufacture gas fixtures and appliances in New York City, has been incorporated with a capital of $12,000. The Directors are Messrs. Arnold Auerbach, Alexander Kaufman and Abraham Auerbach, all of New York.

ARRANGEMENTS have been completed under which the Cleveland (O.) Gas Light Company will extend its mains to Glenville for the purpose of supplying the residents of that suburb with gas.

W. L. BUTLER, who formerly was Cashier to the Hyde Park Company —Hyde Park is a suburb of Chicago—was recently indicted on five charges of embezzlement. He subsequently pleaded guilty to petty larceny, and was sentenced to three months in the county jail.

A VERY odd suit is now underway in the Court of Common Pleas, No. 2, Philadelphia, in which Messrs. Jas. Cochan & Co., of that city, claim damages from the Philadelphia and Reading Railroad Company, for the destruction by fire, in December, 1893, of their yarn and woolen mill. In their statement they ascribe the destruction of the mill to inability to get at a gas valve and stop the flow of gas. They say that access to this valve on the service pipe leading from the street main was cut off by the change of grade of Columbia avenue for the building of the bridge across the Company's tracks at 9th street. Prior to the change of grade the gas could be turned off in the mill by a key inserted in the valve, but owing to the negligence of the Railroad Company in constructing the bridge and changing the grade of Columbia avenue several feet of earth was dumped over the valve. The net loss incurred through the fire was $40,104.78, the value of the property destroyed amounting to $193,696.28, on which $151,591.50 was recovered. Complainants held the Railroad Company liable for the loss, asserting that the fire could have been extinguished if the gas could have been cut off, as is the usual custom, by the employees of the Gas Bureau.

THE following cleverly compiled pamphlets were issued by the Lawrence (Mass.) Gas Company :

"LAWRENCE GAS COMPANY, Lawrence, Aug. 1, 1894.

"*Gas Piping.*—Are you going to build ? If so, let us give you a few pointers suggested by experience. Of course you are going to pipe the house for gas—by all means do this, even if the gas mains do not run near your house, because it is very easy to pipe a house while it is being built, but difficult to do so afterwards ; and as a thing worth doing at all is worth doing well, it follows that it is well to have the piping of sufficient size. Many and many a complaint of poor light is made and the trouble attributed to the gas, when the real cause is that the piping of the building is too small, yet the difference in cost between a good job and a poor one is trifling. In a house, say of 10 rooms, the riser, that is, the pipe leading from the meter, should not be less than 1 inch, and the pipe should be carried up in this size to the second story, and in branching off to the fixture lights, keep the size of the pipe ample. Where more than a single light is to be fed from one pipe, let it be half inch or more, otherwise three-eighths, except where the pipe comes up from the floor to a bracket, which may be quarter-inch, but three-eighths would be preferable. It will be well worth the while to devote

a little thought to the arrangement of the lights, so that you may have light where you want it. Are you going to have a light outside the front door? Let the pipe come from the ceiling of the first story, let the pipe be not less than half-inch, and be run with an incline or pitch to the house, so that any vapor condensing in the pipe will run back to the building, and the tee or fitting from which the fixture is to be fed should look up instead of down, and the connection made with the fixture by elbowing over. This will be a further preventative against moisture collecting in the fixture. Use a storm-proof shade and let the stopcock for the fixture be inside the house, so that you can shut the gas off without leaving the house, and you will have a satisfactory light. It is well to use here a 'half-turn' stopcock, and so stopped that by turning in one direction the gas will be shut off completely, while if turned the other way enough gas will pass to keep the lamp alight; then, if the light should be desired in the night, a quarter turn of the stopcock will effect the object. In arranging parlor lights, do not forget the piano; plan to have a gas bracket each side of this instrument. A new scheme is to have a gas connection at the base board near the piano, and have it connected to a so-called piano lamp, fitted to burn gas and supplied with a Welsbach burner. For reading purposes you want an Argand or else a Welsbach burner, which can be arranged by having a sliding fixture or a portable on the table; if the latter scheme is adopted, it is preferable to have the chandelier made with a special stopcock for such attachment. In each case we would suggest, in both parlor and library, at least one bracket light placed rather low, say 5 feet from the floor; it will prove an excellent reading light; place it where you propose having the lounge, and call it the lazy man's light or give it any other name you like, but you will find it handy. A very pretty effect is produced by having a pair of lights come out on the mantelpiece; on 'state occasions' these can be used for decorative effects very nicely. These are also very serviceable when it is desired to read while sitting by the gas log, which we speak of in another circular. In the dining room a ceiling light with an Argand is what is required over the table; supplement this by a couple of lights over the mantelpiece, or one on each side of the sideboard. In the kitchen good light is required, and it can best be obtained by a ceiling light and one bracket—the latter over the working table; but don't arrange a bracket light at one end of the room and have the working table at the other. In the laundry, if the ironing board is to be in the center of the room, have a center fixture; if it is to be against the wall, use a bracket light and let it come opposite the middle of the board; or, better yet, as far as efficiency is concerned, though it will look odd, have an overhead fixture and let the light come down over the ironing board. If the room is too low for an ordinary ceiling pendant, it is feasible to have such a fixture arranged with a swing, so when not in use it can be swung up toward the ceiling and secured in that position. True, after long usage and no care, such a joint may leak, but with an occasional greasing such a fixture will do good service. Arrange a cellar light to be fed from a pipe passing by the head of the cellar steps, and have a stopcock arranged similar to the one at the front vestibule; then it is possible to light the gas in advance as you go down stairs, and turn it down after you as you come up. In large chambers have an outlet in the center of the room for a chandelier, and a pair of bracket lights at the dressing bureau, or an outlet over the same for a so-called boudoir chandelier. In the sewing room, in addition to the center light, have at least one bracket light—if the room be large, two—and let them be about 4 ft. 3 ins. from the floor; then spectacles will not be so much in order. If the room is too low-studded for a center light, have at least two brackets. If building a business block, and you are tempted to run the gas pipe up from the cellar through a cold hall, we would say—don't. We have some suggestions for heating houses which you may have for the asking.—C. J. R. HUMPHREYS, Agent."

THE second circular, which also bears the signature of Agent Humphreys, relates to "House Heating," and is as follows:

"Progress is the order of the day, and in domestic science this remark holds good as in other directions, hence we note the general substitution of the gas cooking stove for the ordinary coal range. This change is now so well established that it behooves one in planning a house to arrange accordingly. Hence we would suggest, if you are building a house or re-arranging an old one, to include in the lay-out of the gas pipes a separate pipe three-quarters of an inch in diameter, to run from a point near where the gas meter will be set to the kitchen. It is preferable to arrange to dispense entirely with the coal range; this can be done by attaching a water heater to the gas stove and by planning to heat the kitchen by the ordinary heating apparatus of the house boiler or furnace, as the case may be. This will be found to be a great convenience, as in the winter season the kitchen will be found to be as warm as any other part of the house. The circulating water system of the house may be connected with a water heater—similar to the water back of a coal range—or it is practicable to have a small separate water heater. There is hardly a room in a house which would not be the more comfortable and cheerful by the addition of a gas heating stove of one kind or another. In the hall, a gas grate connected with a chimney (provided a chimney runs through this portion of the house) would be most acceptable, in that it would take the chill off the air on a spring or fall day, when the heat from a boiler or furnace would be oppressive. In the library a gas log would add its share of cheerfulness to the room and would do efficient service, provided the throat of the grate is fitted with a damper, so that all the heat does not go up the chimney. This can be easily done while the house is building. For the parlor and dining room we would suggest a gas grate or a verity fire—that is, a gas burner over which is placed a mass of hollow fireclay balls; these are brought to a bright incandescence by the gas and give off a fine heat. In the nursery it would be well to arrange for a gas stove and have a small opening in the chimney for flue connection, say 3 inches in diameter. Then the gas stove can be used at any time without harming the atmosphere. A similar arrangement would be well in the bathroom, and in this room provision should be made for an instantaneous water heater, to be placed between the bath and wash basin. Matters should be so planned, as to permit of a connection between the water heater and the chimney. If you are going to build we would suggest that the plans be made so that you can add these Nineteenth Century additions to your home conveniences as you may desire. They are easily put in when a house is building, but difficult to add afterwards. Even if it is thought that they would not be made use of in the immediate future, still we would suggest that they be incorporated into the plan of the house. Let all the gas pipes for such grates and stoves be on a system distinct from the lights, because otherwise the gas lights may flicker as the heating apparatus is turned off or on. Have the pipes of ample size (1 inch) to the top of the first story, with three-quarter branch to the point where the pipe leads up to the grate or stove; then it can be reduced to one-half inch. The cost of such a pipe system would be but little, and will be thoroughly appreciated subsequently."

MR. C. D. HAUK, formerly prominent in the management of the National Gas and Water Company, of Chicago, is now connected with the National Heat and Power Construction Company, with headquarters at 130 South 6th street, Philadelphia. He is Vice-President and General Manager of the Company, which was formed for the purpose of erecting gas plants to be operated under the Rose-Hastings process. A specialty of the Company is the building of auxiliary plants for natural gas companies.

THE plant at Aberdeen, South Dakota, is being overhauled, the work of reconstruction having been intrusted to Mr. Bartholomew.

THE Board of Gas and Electric Light Commissioners will hear the application of the Brookline (Mass.) Gas Light Company for the right to increase its capital stock from $1,000,000 to $2,000,000, at 10 A.M. of September 5th.

THE residents of Wellington (a suburb of Malden, Mass.), have petitioned the proprietors of the Malden and Melrose Gas Company to extend the main system to that suburb.

LAST week we reported that a project was on foot for the establishing of a gas works in Provincetown, Mass., and it seems that considerable opposition to the plan has been aroused. This opposition has for its leading spokesman the Provincetown *Advocate*, which asserts that the town ought to go into the business on its own account. The *Advocate* further believes that an electric lighting plant should be arranged for rather than a gas plant. The same authority, however, admits, "It would be hard to find a town of the size of Provincetown which is so utterly destitute of the proper facilities for lighting its streets."

THE Calais (Me.) Company will enlarge its distributing system by placing several thousand feet of 8-inch and 6-inch mains.

THE Superior Gas Governor Company, of Tacoma, Wash., has been incorporated by Messrs. S. F. McNally, L. G. F. Hayes and Lewis Anderson. It is capitalized in $5,000.

THE Los Angeles (Cal.) Lighting Company has completed an extension to its purifying capacity, and the improvement now in hand con-

sists of betterments to the main system. A 12-foot station meter has also been installed.

ANOTHER mysterious Gas Company is projected for Chicago. Its title is that of the Plant Gas Company, and its capital is put at $3,000,000. The incorporators are F. Rosebrook, John N. Coffin and Manton Maverick.

THE stock jobbing fraternity of Montreal have been telling the investors of that city that negotiations were almost completed under which the old Montreal Gas Company and the Consumers Gas Company were to be consolidated. We can and do say, however, that the conflicting interests named are as far apart as ever, although this statement is not to be considered as meaning that certain factions in each Company favor amalgamation. From surface indications it would seem that the old Company has much the better of the contest up to date.

MR. CHAS. A. BENNETT, JR., the versatile Manager of the Freehold (N. J.) Gas Light Company, intends to popularize the use of gas for cooking purposes in the heart of Monmouth county; not that he has not had some measure of success in this line, for perhaps 200 stoves of all sorts are now in service. These, however, are mostly of the smaller order, and as a demand for ranges of the first class exists, he proposes to give the residents just what they want. He has fitted up a handsome showroom in a well situated store at the corner of Main and Sheriff streets, where a complete line of gas cookers, etc., will be on display, all under the charge of a person competent to explain the correct way of operating the apparatus in an efficient and economical manner. Bennett will make "a go" of it.

HENRY S. MCDONALD, proprietor of the Catonsville Hotel (Catonsville is a suburb of Baltimore, Md.), was recently arrested, at the instance of the Consolidated Gas Company, of Baltimore, charged with using gas without the usual formality of having the illuminant registered on a meter. The meter was bye-passed. Defendant gave bail to appear before Justice Albert Smith, at the September term of the Baltimore County Court. Defendant at the last session of the State Legislature was Postmaster of the Senate, and was Register of Baltimore county for several years. Likely, he is a Gorman democrat.

MR. J. F. CAMPBELL has resigned his position as Superintendent of the Eastport (Me.) Gas and Electric Light Company in order to accept a responsible post with the Maine Water Company, at the latter Company's Bath division.

THE Brookline (Mass.) Gas Company is adding a very complete purifying house to its Allston plant.

MESSRS. HUMPHREYS & GLASGOW have closed a contract with Messrs. Lawrence Turnure & Co., of this city, for a single set of 6-ft., double superheater water gas apparatus, complete, for Santiago, Cuba. This will be an apparatus exactly similar to that successfully introduced by Mr. Glasgow in Europe.

WE imagine that the controversy over the gas rate at Minneapolis, Minn., is virtually settled, President Brown, of the Company, having forwarded a proposition to the Committee on Gas of the City Council, which proposition was subsequently reported on by the Committee in the following terms:

"Since the Arbitrators fixed $1.30 as a reasonable price for gas, the Committee has received another proposition from the Gas Company, proposing to reduce the price to $1.40 and to $1.30 when the output shall reach 275,000,000 feet, upon the understanding that no ordinance be passed by the Council. The Gas Company in making this proposition assumed that the output this year would reach 275,000,000 feet, while in fact the output last year was only 250,000,000 feet, and that 50,000,000 feet of that amount was sold to the city on special contract for about $1 per 1,000 feet. That being the case, they urged that as the Arbitrators fixed upon $1.30 as a reasonable price on an output of 275,000,000 feet, it was but fair that the Company should have $1.40 at the present time for metered gas. Your Committee carefully considered these propositions and we declined to act on the Gas Company's proposition, and in turn invited the Gas Company to furnish gas to the people at $1.30 per 1,000 after Sept 1 next, and agreed that if this were done we would recommend that no ordinance fixing the price of gas be fixed. This the Company refused to do and sent another proposition, given below. After careful consideration we have decided that the Council can do no better than accept the last proposition, which is as follows:

"In case no attempt is made by the Council to fix the price of gas, we will either reduce the rates Sept. 1 to $1.40 per 1,000 feet and make further reduction to $1.30 when our total sales shall reach 275,000,000, or else we will maintain the present price until March, 1895, and announce a reduction to take place at that date to $1.30 per 1,000 feet. We are willing to adopt either proposition our customers may prefer. In making the proposition we do not in any manner concede or admit that the city has any lawful power to fix a price to be inserted in private contracts between this Company and its customers, and as the assertion of such power would involve the life and solvency of our Company and its whole business, we should be compelled in self defense to resist any such assertion to the fullest extent, and in that event it would be impossible to say now whether any reduction in price could be made to one customer during the pending of the litigation."

Construction and Equipment of a Modern Power Station.

Prof. H. J. Ryan, of Cornell University, says that the amount of floor space required per horse power varies from 9.5 square feet for plants of 2,000-horse power and upwards, to 22 square feet for plants of 100-horse power and under. A fireproof building of brick and iron may be estimated to cost about $40 per horse power for 100-horse power plants, which, for plants of 2,000-horse power and over, falls to $17 per horse power. The best type of engine for railway power stations is the compound condensing engine, and the engine capacity should be from 20 to 25-horse power per car operated. The actual amount required varies from 15 to 18-horse power per car, sometimes rising to 20 on steep grades. The estimated cost of steam plant is from $45 to $55 per horse power for high speed, and $65 to $75 per horse power for slow speed engines of the Corliss type. A power station generator must be absolutely automatic, in practice as well as theory.

Machines that do not give an increase of pressure proportionate to load work badly when coupled together. The cost of the electric generating system, including switchboards, should be from $35 to $40 per horse power. The switchboard must be mounted on an incombustible base, and a rheostat, voltmeter and dead-beat ammeter provided for each generator. A trustworthy form of lightning arrester and a safety circuit breaker which will act promptly at the point at which it is set, are absolutely essential. Fuses are less reliable than magnetic devices for this work. An essential feature of the switchboard should be an equalizing bar which places the series coils of all the machines in parallel with each other, and thereby prevents the possibility of any generator acting as a motor in case its potential accidentally falls too low, a circumstance liable to result in a serious injury to the machine.

Precautions in First Starting New Engines.

Engineering Record very pertinently says it often happens that new engines on first being started are injured by the cutting of the cylinders and the valve seats. The surfaces of these important organs, which ought to be perfectly smooth and true, are frequently scratched or scored at the very outset, and damaged to a greater extent than they ought to be by a long period of hard service. The parties who install the engine are apt to accuse the engine driver as being the cause of the trouble, on the ground that he has not given the engine proper care. He is charged with neglecting the lubrication of the valves and cylinders. Not infrequently it is claimed that the oil introduced into the cylinders is of inferior quality, and the surfaces fail to be properly lubricated.

In a large majority of cases where these injuries have taken place it is most reasonable to attribute them simply to the action of grit and foreign matter which finds its way into the cylinders, and its presence is due to the fact that the steam pipes and cylinders have not been properly cleaned and blown out previous to the first starting of the engine.

No one would deny that foreign matter is present in the pipes and cylinders during the process of installation, and that unless removed it is liable to do injury in this very manner, and no one would think of starting an engine without making some effort at least to clean out the pipes, and take steps to prevent injurious action of this kind; but it is believed that too little care is exercised in this important matter, and that, as a rule, the efforts which are made are inadequate to attain the desired end with absolute assurance. It is generally thought sufficient to blow the pipes out for a period of only a few minutes. In reality, the efforts in this direction would be well spent if a considerable current of steam were allowed to pass through for several hours' time. If this were done, not only for the piping, but also for the passages in the cylinder leading to the steam ports, there would doubtless be fewer cases of cylinders being cut and valve surfaces scored on new engines.

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MONDAY, AUGUST 27, 1894.

The Market for Gas Securities.

The city market for gas shares showed unusual animation for this season, the feature being a sharp rise in Consolidated, 804 shares of which were traded in on the Exchange on Thursday, the range being 125 to 127. The opening to-day (Friday) was 124 bid, offered at 125, and the outlook to us seems to be in the direction of an easier feeling, prompted by the desire of those who bought at 122 or under to take their profit. Equitable is steadily inquired after, and holders predict considerably higher prices in this specialty before the end of September. Mutual is firm, with only odd lots offering on the street. East River common is offered at 19, but we do not know anyone who is offering that much for it; the same Company's preferred is quoted at 25 to 35, and the bonds are offered at 80. We have no bid figures for the bonds. The Brooklyn situation is virtually unchanged, although piping operations are going on. We understand that the Metropolitan Company's main system is being connected to the old Brooklyn Company's system, which lends color to the view that the plant of the last named will sooner or later be closed. Quotations are nominal only. Chicago gas is strong, at 77 bid, and many believe that the Hyde Park Company and the Chicago combination have arrived at a friendly understanding. The Universal Company's mystery will soon be exploded. Bay State gas is strong, at 19 bid, and Consolidated of Baltimore is at the prices named a week ago.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks.

16 WALL ST., NEW YORK CITY.

AUGUST 27.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	124	125
Central	500,000	50	103	—
" Scrip	220,000	—	100	—
Equitable	4,000,000	100	165	—
" Bonds	1,000,000	—	106	108
Metropolitan, Bonds	658,000	—	108	112
Mutual	3,500,000	100	145	—
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	80	95
" Bonds	150,000	—	—	100
Richmond Co., S. I.	348,650	50	50	—
" Bonds	100,000	—	—	—
Standard Gas Co—				
Common Stock	5,000,000	100	25	30
Preferred	5,000,000	100	80	—
Yonkers		50	112	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	102	104
Citizens	1,200,000	20	50	—
" S. F. Bonds	320,000	1000	—	101
Equity Gas Light Co.	2,000,000	100	—	—
Bonds	1,000,000	—	—	—
Fulton Municipal	3,000,000	100	—	126
" Bonds	300,000		103	—
Peoples	1,000,000	10	—	70
" Bonds (7's)	368,000	—	100	—
" " (6's)	94,000	—	98	100
Metropolitan	870,000	100	—	136
" Bonds (5's)	70,000	—	—	155
Nassau	1,000,000	25	—	155
" Ctfs.	700,000	1000	99	100
Williamsburgh	1,000,000	50	135	140
" Bonds	1,000,000	—	107	110
Out of Town Gas Companies.				
Bay State Gas Co.—				
Stock	5,000,000	50	19	19¼
Income Bonds	2,000,000	1000	60	—
Boston United Gas Co.—				
1st Series S.F. Trust	7,000,000	1000	78	—
2d " " "	3,000,000	1000	57	58
Buffalo Mutual, N. Y.	750,000	100	120	—
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	160	—
Chicago Gas Company.	25,000,000	100	77	77½
Chicago Gas Light & Coke Co.—				
G't'd Gold Bonds	7,650,000	1000	81⅛	81½
Consumers Gas Light Co., Jersey City	2,000,000	100	54	57
Bonds	600,000	1000	92	—
Cincinnati G. & C. Co.	7,000,000	100	192	—
Consumers Toronto	1,600,000	50	184½	187
Central, S. F., Cal.			90	100
Capital, Sacramento, Cal			—	55
Consolidated, Balt.	11,000,000	100	—	67½
" Bonds	6,400,000		107	107½
Citizens Gas Lt. Co., Rochester, N. Y.	500,000	—	85	101
Bonds	250,000		—	—
Detroit Gas Co.—				
Con. Bonds	.....	.....	—	50
East River Gas Co., Long Island City	1,000,000	100	16	19
Preferred	.....	.....	25	35
Bonds	500,000	100	—	80
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1000	—	101
Hartford, Conn.	750,000	25	120	128
Jersey City	750,000	20	190	200
Louisville, Ky.	2,570,000	50	125	130
Laclede Gas Light Co. St. Louis, Mo.—				
Common Stock	7,500,000	100	19	19⅛
Preferred "	2,500,000	100	70½	72
Bonds	9,034,400	1000	88	89
Little Falls N. Y.	50,000	100	—	100
" Bonds	25,000	—	100	103
Montreal, Canada	2,000,000	100	200	208
New Haven, Conn.		25	200	—
Oakland, Cal.			42⅜	43
People's Gas and Coke Co., Chicago—				
1st Mortgage	2,100,000	1000	—	108
2d "	2,500,000	1000	104	105
Peoples, Jersey City	500,000	—	175	185
" " Bonds			—	—
Paterson, N. J.		25	99	102
Rochester, N. Y.		50	80	85
Preferred			90	95
Bonds			90	95
Syracuse, N. Y.	500,000	25	—	—
San Francisco Gas Co. San Francisco, Cal.	10,000,000	100	71	71½
Washington, D. C.	2,000,000	20	240	—
Wilmington, Del.	500,000	50	180	182

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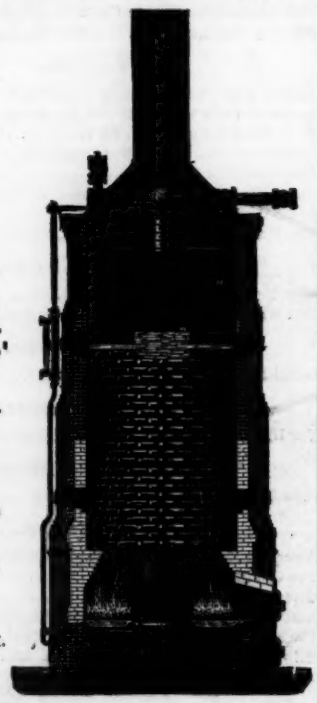

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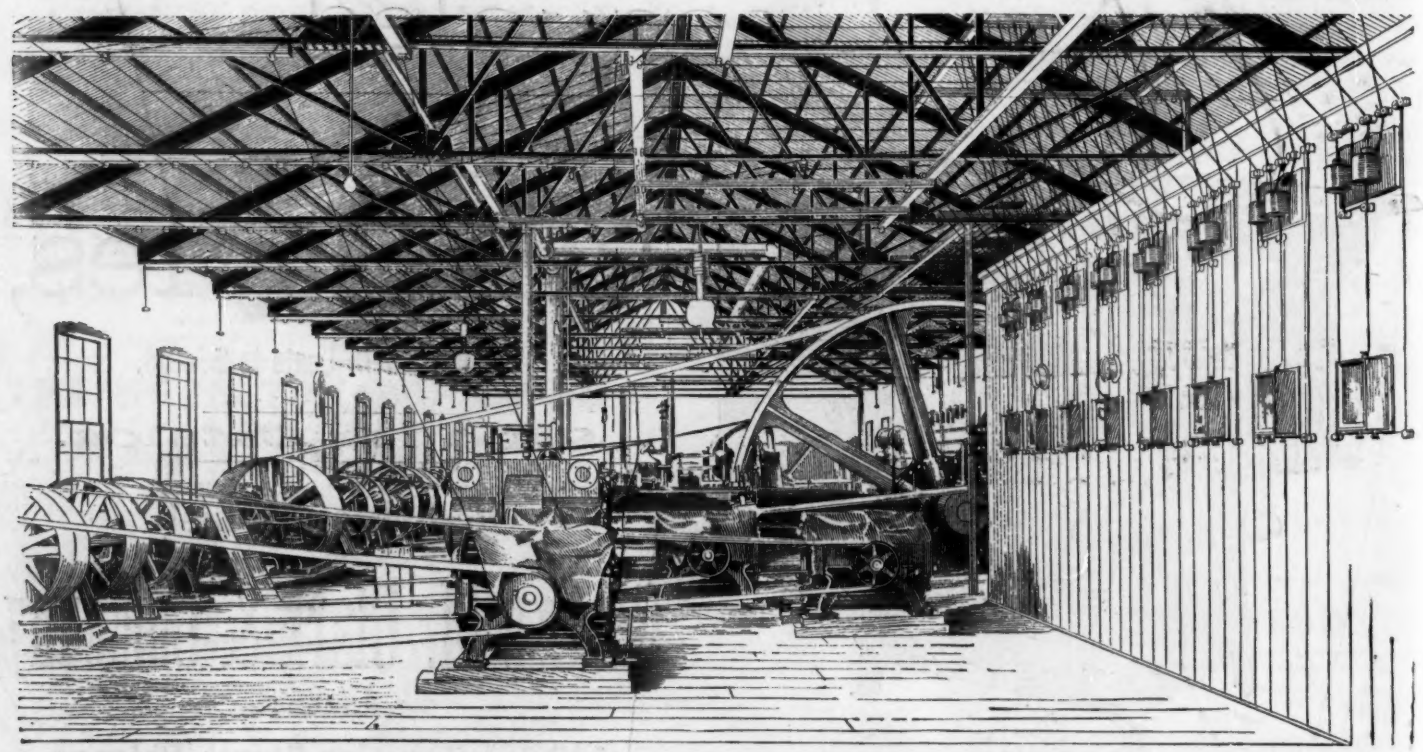

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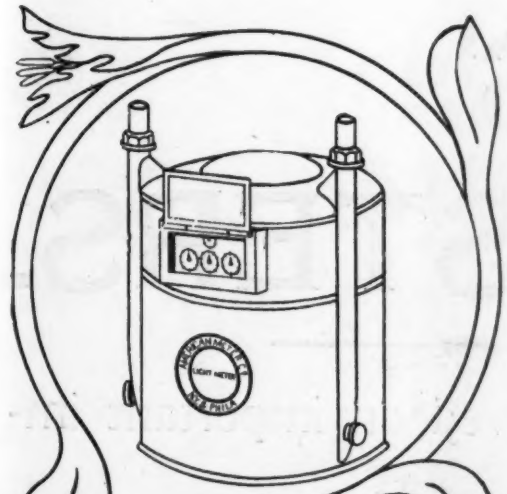

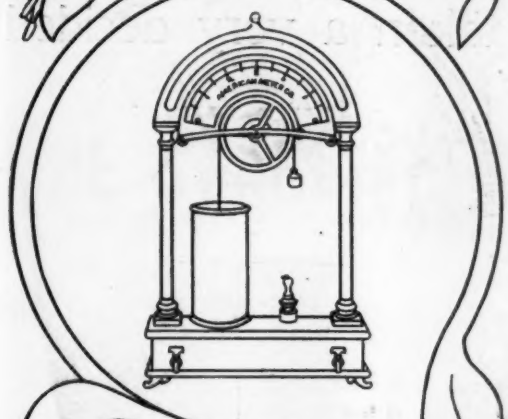

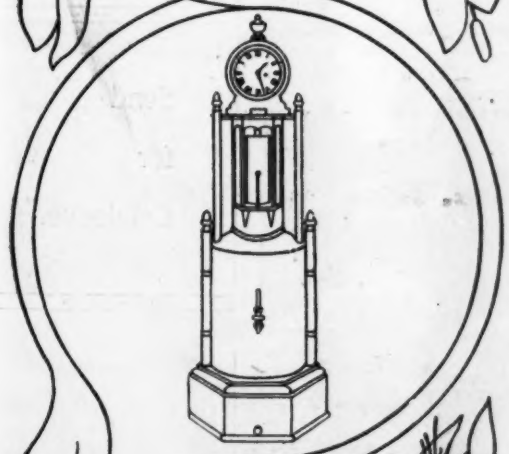

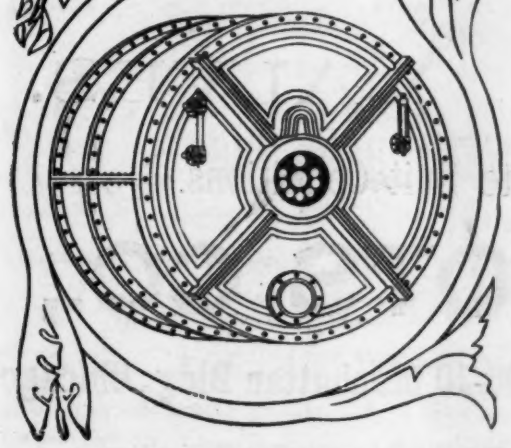

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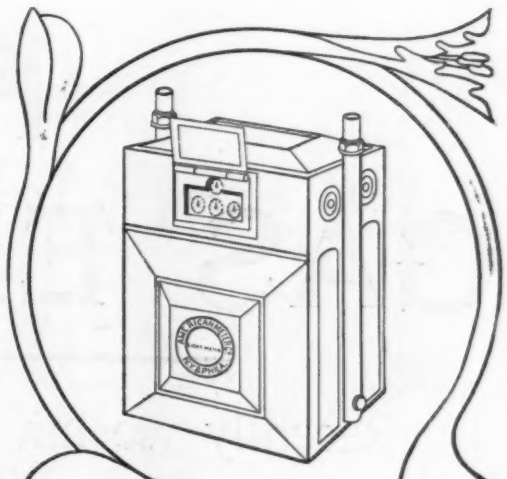
PUBLIC LIGHTING TABLE.

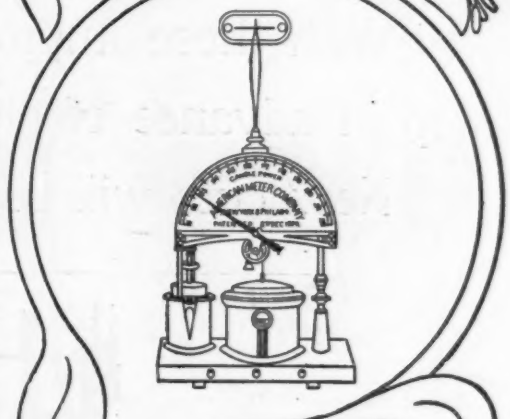
SEPTEMBER, 1894.

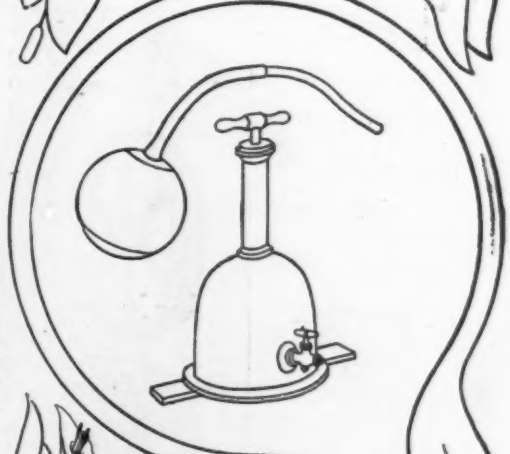
Day of Week.	Table No. 1. Following the Moon. Date.	Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Sat.	1	7.00 PM	4.30 AM	6.30	4.20
Sun.	2	7.00	4.30	6.30	4.20
Mon.	3	7.00	4.30	6.15	4.30
Tue.	4	7.50	4.30	6.15	4.30
Wed.	5	8.30	4.30	6.15	4.30
Thu.	6	9.10 FQ	4.30	6.15	4.30
Fri.	7	9.50	4.30	6.15	4.30
Sat.	8	10.50	4.30	6.15	4.30
Sun.	9	11.50	4.30	6.15	4.30
Mon.	10	12.50 AM	4.40	6.05	4.40
Tue.	11	1.50	4.40	6.05	4.40
Wed.	12	2.50	4.40	6.05	4.40
Thu.	13	No L.	No L.	6.05	4.40
Fri.	14	No L. FM	No L.	6.05	4.40
Sat.	15	No L.	No L.	6.05	4.40
Sun.	16	6.40 PM	7.50 PM	6.05	4.40
Mon.	17	6.40	8.10	5.55	4.50
Tue.	18	6.30	8.30	5.55	4.50
Wed.	19	6.30	9.10	5.55	4.50
Thu.	20	6.30	9.50	5.55	4.50
Fri.	21	6.30	10.40	5.55	4.50
Sat.	22	6.30 LQ	11.40	5.55	4.50
Sun.	23	6.30	12.50 AM	5.55	4.50
Mon.	24	6.20	2.10	5.40	5.00
Tue.	25	6.20	3.30	5.40	5.00
Wed.	26	6.20	4.50	5.40	5.00
Thu.	27	6.20	4.50	5.40	5.00
Fri.	28	6.20	4.50	5.40	5.00
Sat.	29	6.20 NM	4.50	5.40	5.00
Sun.	30	6.10	5.00	5.40	5.00

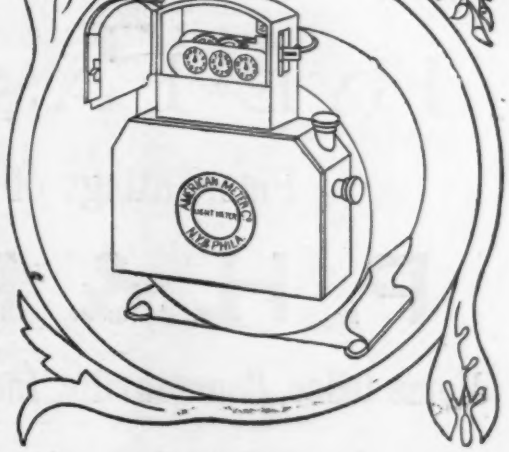
TOTAL HOURS LIGHTING DURING 1894.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	244.10	January	423.20
February	195.30	February	355.25
March	206.20	March	355.35
April	169.40	April	298.50
May	162.10	May	264.50
June	135.40	June	234.25
July	146.30	July	243.45
August	162.20	August	280.25
September	174.10	September	321.15
October	211.20	October	374.30
November	221.00	November	401.40
December	245.30	December	433.45
Total	2274.20	Total	3987.45









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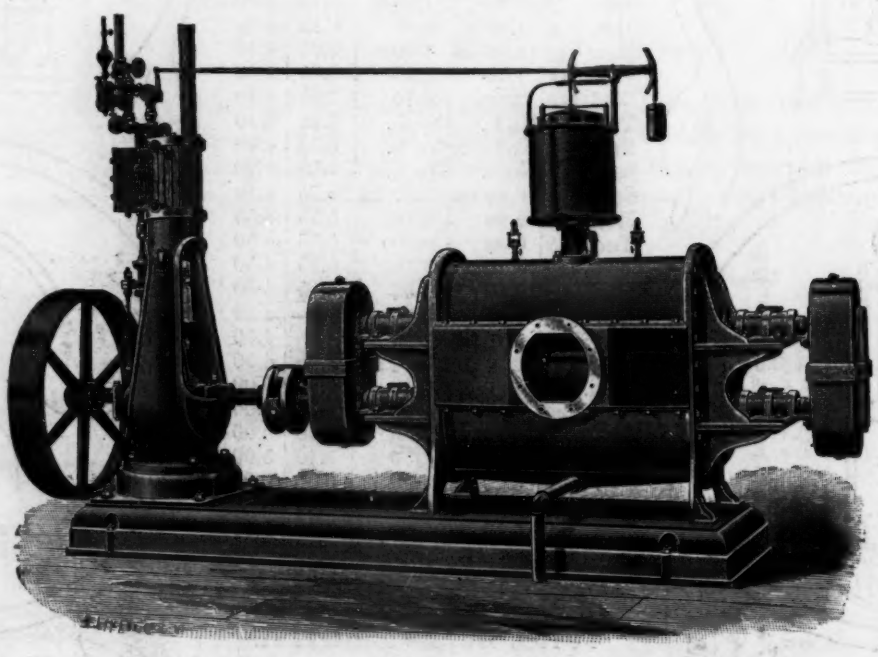

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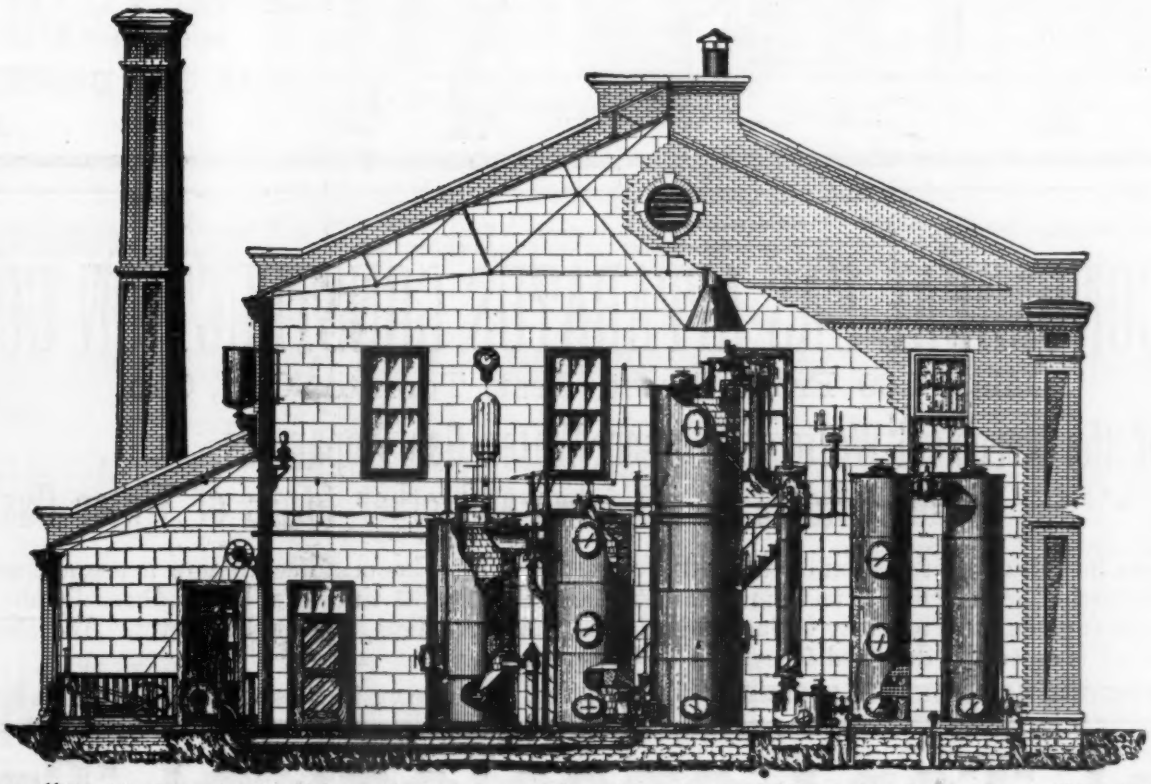

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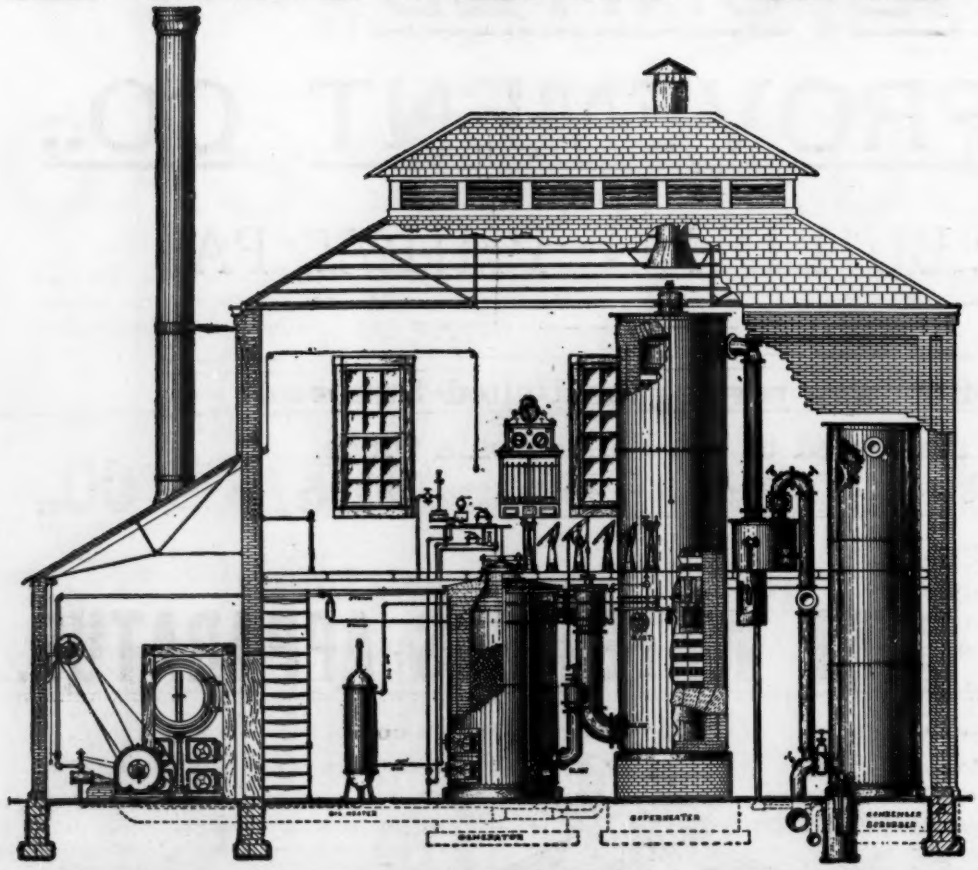

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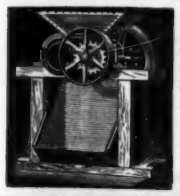

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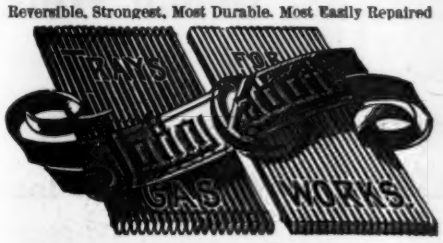

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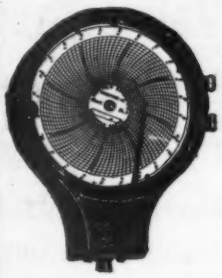

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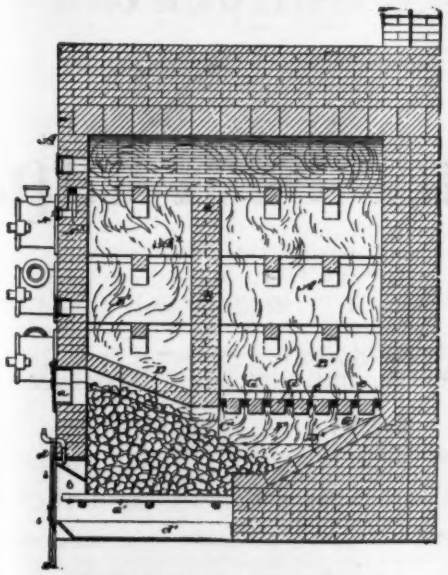

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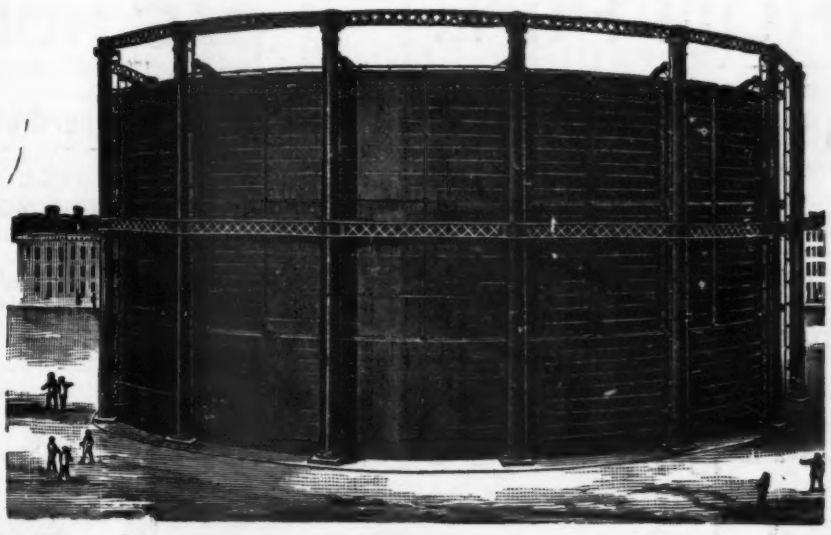

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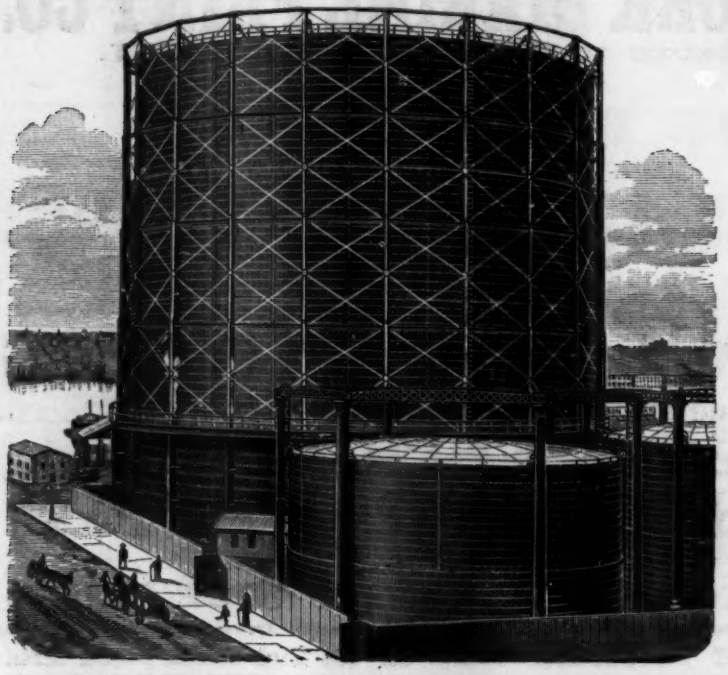

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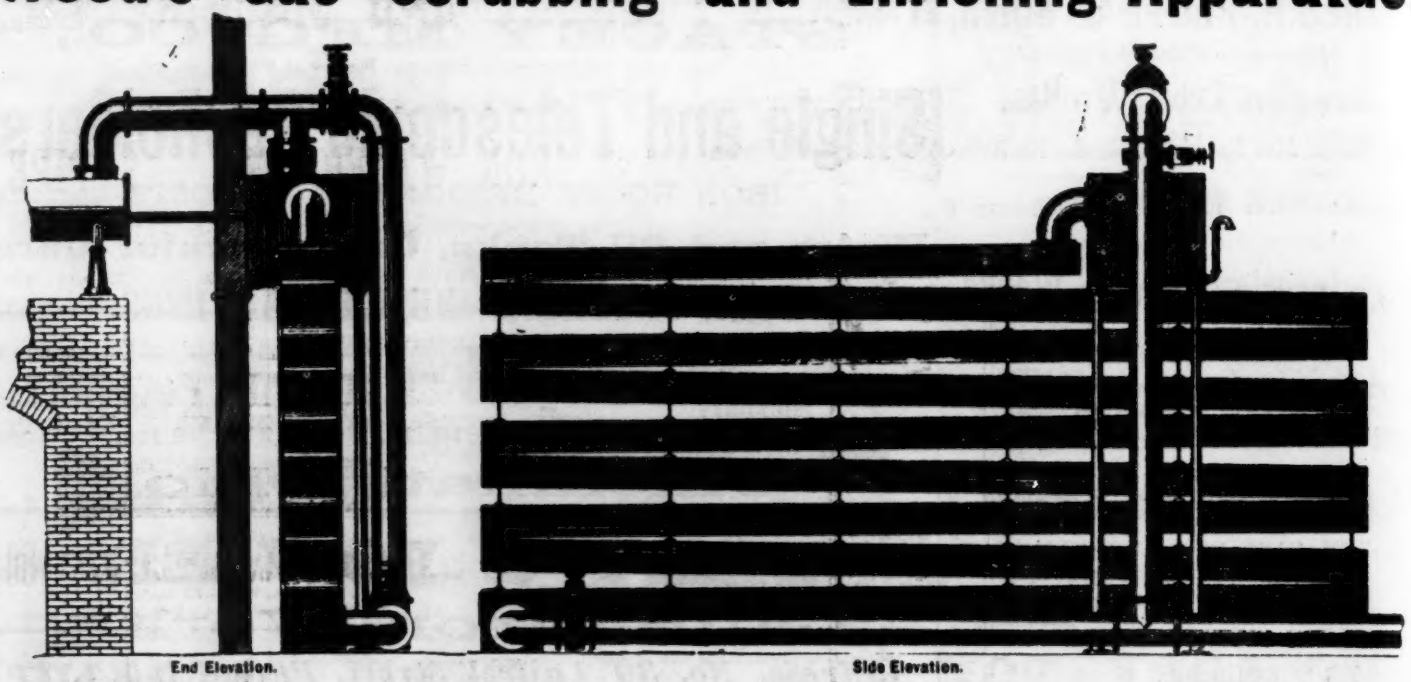

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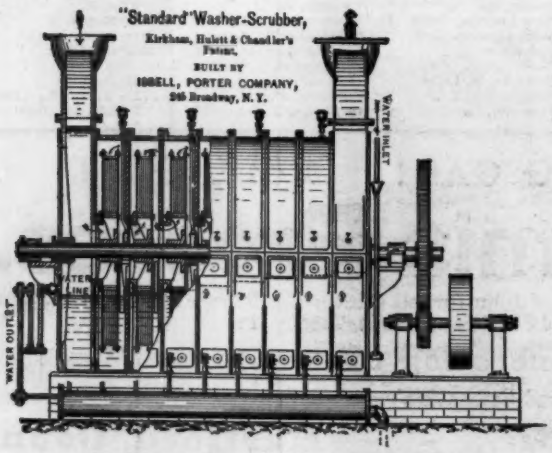

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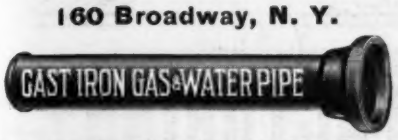

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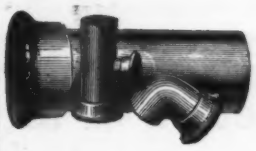

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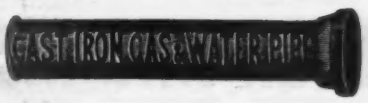

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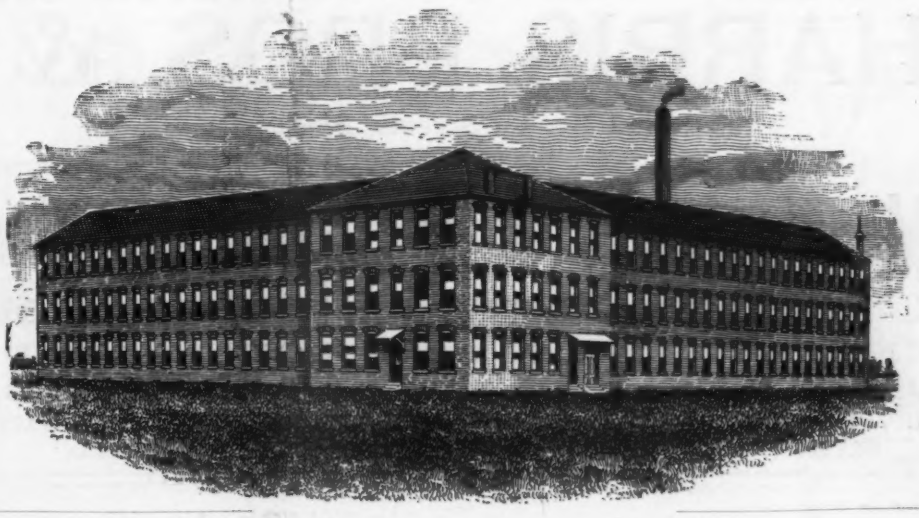

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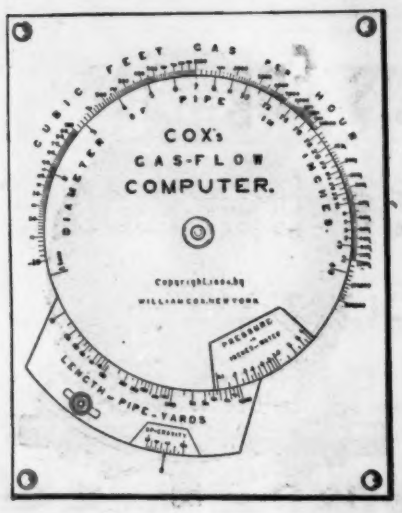

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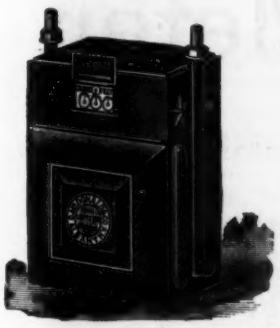

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